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[No. 1.

Spread of Loranthus.

I well remember what a pest the Loranthus used to be among the sal forests of the Siwaliks and what a puzzle it sometimes was, in consequence, to know how to act. The Lakarkot Block of the Saharanpore Division used to be particularly bad in this respect and when the improvement fellings were being made there, it came to be a nice problem to decide which trees out of such a crippled lot to choose for reservation. Fine young patches of sal poles in many cases had every individual attacked by one or more of these parasites and the only choice left was to retain the least injured tree or the one whose leader, at any rate, was still intact.

These recollections of the jungles round Dholkhand came to my mind with great distinctness as I was listening not long ago to a paper on "The Dispersal of Mistletoe" in Australia, read before the Field Naturalists' Club of Victoria by Mr. H. P. C. Ashworth, the Honorary Secretary of the Club, and as I am sure it will interest the readers of the "Indian Forester," I enclose it. In the discussion which followed the reading of this paper one member stated that *Dicæum hirundinaceum* was common near the Gulf of Carpentaria, from which it would appear that the species spreads well into the tropics or has perhaps spread from the tropics down into the temperate regions of the South. There are several species of *Dicæum* in India, though *D. hirundinaceum* is not given in Jerdon and probably is not found beyond the Australian region. Some of these Indian species may in their habits resemble this particular Australian one and it is in the hope that somebody will make the necessary observations and settle the point, that I am now sending you these remarks. The supposition seems probable and is supported by the mention made in the paper of "banian" seeds being spread in this way, though I always imagined that green pigeons were the chief agents in dispersing the epiphytic forest figs,

Mr. Ashworth has very kindly lent me a stuffed specimen of *D. hirundinaceum* and a diagram of the Loranthus fruit, showing the opening made by the bird. I enclose a copy of the diagram and a rough, outline sketch of the bird life-size. In this species the head, back, wings and tail and the wing—and tail-coverts—are dusky brown shot with blue-purple; throat, breast and under tail-coverts scarlet; breast white, more or less clouded; beak and legs black. I believe no Indian *Dicaeum* is marked much like this, but the general shape and appearance will be about the same and the characteristic beak. This last is short and though broad at the base, has a sharp point with a marked ridge running along the top from the base to the point.

Mr. Ashworth's observations were so careful and so complete that I do not think there is any room left for doubt as to the *Dicaeum* being at any rate a very important, and probably the chief, agent in the distribution of Loranthus in Victoria. The spread of *Loranthus europæus*, as well as of the true Mistletoe, in Europe, is generally attributed to the missel thrush, but possibly further observation may show that other birds have a share in the work.

At any rate it would be interesting to know exactly what bird is answerable in the various part of India for spreading Loranthus through the forests, and whether it carries all species of the parasite indiscriminately or not. In Lakarkot, *Loranthus longiflorus* was the commonest, but not the only species, two or three others were, I think, also far from rare.

Even when we have this information, we shall still be far from a solution of the problem of getting rid of Loranthus, though it will be a step in the right direction. Dr. Hess, in his "Forstschutz" asserts it would be a mistake to shoot mistle-thrushes on account of their value as destroyers of insects. Curiously enough the *Dicaeum* can claim a similar value. It is generally looked upon as insectivorous and belongs to an eminently insect-eating family.

MELBOURNE.

22nd October, 1895. }

M. H. CLIFFORD.

From the August number of "The Victorian Naturalist," the Journal and Magazine of the Field Naturalists' Club of Victoria.

THE DISPERSAL OF MISTLETOE, BY H. P. C. ASHWORTH.
(Read before Field Naturalists' Club of Victoria, 8th April, 1895.)

"The wide prevalence of parasitic mistletoes high up in the branches of even our loftiest eucalypts is noteworthy, and although it has long been known that birds are the agents in dispersing the seeds, still the extent to which one small bird contributes does not seem to have been recognized. The bird referred to is the pretty little Swallow *Dicaeum*, *Dicaeum hirundinaceum*, which, so far as my observation go, seems to be the exclusive agent in Australia.

The general facts of the inter-relation of plants and animals are now fairly well understood, the broad deductions being that by the process of variation and natural selection all our brightest flowers have been evolved to attract insects to fertilize them, and our most delicious fruits to entice birds and mammals to eat them and disperse their seeds.

As an instance of the latter, Wallace cites the case of the nutmeg, which is eaten by fruit pigeons for the sake of the mace surrounding it, this latter being merely an adventitious growth to attract attention. The nutmeg passes through the bird's body and germinates where it falls.

In Europe, the chief agent in the dispersal of mistletoe appears to be the Mistletoe or Missel Thrush, *Turdus viscivorus*, the specific name of which, signifying "mistletoe eating," was given to it by Linnæus on that account; indeed, it was long thought that this bird was a sort of foster-parent to the mistletoe, and that the seeds would not germinate unless they had first passed through its body. The European mistletoe (*Viscus*) has a soft skin, and is eaten by the birds whole, but our mistletoes belong to the genus *Loranthus*, the seeds of which are encased in a hard berry, and the wonderful adaptation of the Swallow *Dicaeum* to the rôle of extracting them is remarkable. The fruit of the mistletoe ripens about the month of May and the Swallow *Dicaeum* then appears in large numbers. Intent on observing them, I set off one day with a telescope to the junction of Gardener's Creek with the Yarra, where there is a fine clump of box * trees, covered with mistletoe. After watching the birds for some time through the telescope, I found that they first plucked a berry then repaired to a larger bough, whence after a few moments the berry was dropped. I had always thought that the berry was eaten whole, but on picking one up the mystery was solved, for it was empty; the seed, with its glutinous covering, had been abstracted through an opening in the top, formed by biting it nearly through, leaving a lid. Nor is this all, for in the act of picking the fruit, a small hole is left where the stalk joined it and this must greatly facilitate the sucking or squeezing out of the contents. During the whole process the bird uses only its beak. The ground underneath each of the trees was strewn with several hundreds of these discarded berries, each with its lid at one end and the small hole at the other.

The bird is so small that when the seed is passed it sticks to the bough on which it sits, and is glued there by its viscid covering. On climbing the trees, I was surprised to find what a large number of seeds were sticking to the branches.

Consul Layard writing to "Nature" from Noumea (see *Victorian Naturalist*, Vol. V., p. 72), speaks of the Indian species of

* A species of Eucalypt. M. H. C.

the genus *Dicæum* as the agent of dispersion of the banian, and says that the seeds require to pass through the bodies of the birds to enable them to germinate. To determine whether this holds with our mistletoes, I planted and marked a number of seeds on several trees. Two months afterwards, in July last, they began to sprout and send their roots into the wood of their hosts, and continued to grow equally as well as those passed by the birds. School-boys are fond of the berries for the sake of the glutinous covering of the seeds, which is very sweet, and suck them in exactly the same way as the birds.

The Swallow *Dicæum* is recorded from all parts of Australia, and its migrations are probably regulated by its food supply. I am convinced that in Victoria, where it only stays in any number for three or four months, it is the exclusive agent in the dispersal of mistletoe, and should be glad to hear from observers in other colonies the time of its appearance, and the extent to which it is noticed feeding on the berries.

NOTE.—The subject of the dispersal of the seeds of the many Indian species of *Viscum* and *Loranthus* is one of great interest, and we recommend its investigation to our readers. The genus *Dicæum* is rare in India, occurring only in Assam and Burma, so that other birds are probably concerned in the dispersal.

HON. ED.



Rough Sketch of *Dicæum hirundinaceum*. Fruit of *Loranthus* after being opened by the bird.

The Treatment of Casuarina on Sand Dunes.

Casuarina equisetifolia has been grown to a very great extent, along the sea shore in the Alibág Range of the Kolaba Division and in the Dápoli Range of the Ratnagiri Division, and I am not aware that the Forest Officers who put down the seeds met with any special difficulty in getting them to grow. Perhaps those who sowed the seed will be able to tell us about this for I can find nothing about it on the records of this office. This tree has been grown in large numbers at several places on the sea shore, in some places as close as within five yards of high tide level, and though exposed to the full force of the South-West monsoon winds, and to the adverse influences of the sand, are not the least stunted in growth and are as good specimens of the tree as can be seen anywhere. The compound of my house at Alibág is full of well grown Casuarina trees, straight as an arrow and from 60 to 80 or 90 feet high, and they have been grown and are now growing, on sandy soil with sand all around them not more than 20 yards from high-tide level and with nothing between them and the monsoon winds. They must be about twenty years old now for I fancy they were sown when the Bungalow was built, and that is about the age of the Bungalow.

W. BETHAM.

CAMP DAPOLI.

II.-CORRESPONDENCE.

Dripping of Water from Trees.

SIR,

In the 'Indian Forester' for November 1895, page 420, there is an article on this subject.

II.—In the 'Week's News' (published in the Pioneer Press, Allahabad) for the week ending 16th November 1895, under casual cuttings, is a more interesting article with *The Water Tree* for its heading. This runs as follows:—

"M. Ducharte recently made known to the French Academy of Science the results of an experiment made by M. Maxime Lecomte in Congo upon a tree of the genus *Musenga*. Upon making incisions in the trunk of it and placing a pail at the foot of the tree, more than ten quarts of pure water collected in thirteen hours. The gorillas, it seems, are in the habit of slaking their thirst at these hidden fountains, and regulate the flow of

‘liquid at will by pulling off different sized branches. Many years ago Dr. Wallich found in the province of Martaban, Africa, a plant belonging to the same natural order, whose soft and porous wood discharged, when wounded, a very large quantity of a pure and tasteless fluid, which was quite wholesome, and was used as a beverage by the natives. This plant was named by Dr. Wallich the water vine, and has been placed in the genus *Phytocrene*, which signifies plant fountain.” These plants form a remarkable exception to the usual character of the order, which embraces species that produce a milky juice—such, for example, as the celebrated cow tree, or Palo de Vaca, of South America, which yields a copious supply of a rich and wholesome milk, as good as that of the cow, and used for the same purpose.”

III.—In the said paper for the week ending 23rd November 1895, page 3, under *News in a Nutshell* is found the following:—

“The cow-tree, the sap of which closely resembles milk, is a native of South and Central America. It is a species of evergreen and grows only in mountain regions. A hole bored into the wood or even a wound made in the bark of this remarkable tree, is almost immediately filled with a lacteal fluid, which continues to flow until it coagulates at the mouth of the wound, soon healing the abrasion. This curious fluid is both palatable and nourishing.”

IV.—Also from the creeper *Vitis latifolia* and perhaps other creepers, the Dehra Dun Forest School students often secure enough water to slake his thirst while working in the forest on practical teaching.

K. S. KRISTNAMA ACHARI.

A Forest Departmental Blazer.

DEAR SIR,

I send you some patterns, one of which possibly might do for a blazer. I am afraid, however, the question of having one for the whole of India has fallen through. I obtained some cloth from Burma not long ago for the purpose of adopting the blazer used there, but it was not liked by anyone and I eventually returned it.

If one blazer cannot be found to suit the wishes of everybody, why should not each Presidency have its colours?

G. E. M.

NOTE.—The patterns received, which we regret we are unable to reproduce, are combinations each of dark and light green in stripes with occasional bands of light and dark brown. Blazers are, we believe, rather ‘going out’ now, as they have become so very generally vulgarized at home. Why should we not however adopt the colours which were used by some of the ‘promoters’ of Nancy men and which were, we understand, a simple dark green coat with a narrow white ribbon edging. It is neat and simple and is not the sort of thing which ‘Arry would care to sport on the Margate sands.

HON. ED.

NOTE OF CASUARINA PLANTING.

III.—OFFICIAL PAPERS & INTELLIGENCE.

Note on Casuarina Planting.

By E. P. Popert, Esq., Conservator of Forests, Central Circle, Madras.

The varying and in some districts apparently excessive cost of casuarina plantations induced me to call for information from all districts in the circle in which casuarina is planted. District Forest-officers were asked in December 1893 to furnish the following information :—

- (1) Average yield per acre, age at which felled and net revenue.
- (2) Usual date of formation of nurseries with cost of (a) preparation, (b) watering, (c) permanent and temporary establishment per mensem, and (d) rate of wages paid for coolies with number of months employed.
(This information to be reduced to show the cost per acre of plantation.)
- (3) Cost per acre of planting out, including (a) sinking and cleaning wells with number per acre, (b) digging pits for seedlings, (c) planting out, (d) watering, (e) re-planting casualties and (f) establishment, permanent or temporary.
- (4) With regard to the charges for 3 (d) watering, (i) number of years usually watered and number of months in each year, (ii) cost during first year, second year, and (iii) number of seedlings a cooly is supposed to water per diem and the number of times watered each month.

2. The information has been furnished more or less. It has naturally taken some time to tabulate, as old returns had to be examined. That from Chingleput is particularly incomplete and unreliable. No attempt had been made in Trichinopoly to record the yield per acre. It is evident, and to be regretted, that in these districts in the old days, sufficient interest was not taken to check the work. It is not to be wondered at if the cost has been high. No branch of forest cultural operations lends itself more readily to cheating by subordinates.

3. The following is a summary of the information received, omitting Chingleput, which is not worth tabulating :—

(a) *Average age of felling.*—The average age of felling is ten years.

(b) *Outturn per acre.*—The average outturn ranges between 50 tons in Nellore, and 28 in North Arcot. The plantations in North Arcot are situated some distance from the coast, have less moisture and are altogether less favourably placed. It is intelligible that the growth is slower.

(c) *Cost of Nurseries.*—The seed is sown in nurseries in Nellore, North and South Arcot about February, in Tanjore not until June and in Trichinopoly at various times. There is no reason for delaying the sowing in Tanjore until June, and in future the practice in other districts should be followed. Trichinopoly is somewhat different; as the padugais are liable to flooding during the rains, the formation of the nurseries has to be deferred. The cost of nurseries differs very materially and cannot be accounted for by difference in the rate of wages paid to coolies. In Nellore the cost of nursery for one acre of plantation amounted to 9 annas 1 pie. In Tanjore it would appear the cost has been Rs. 5 per acre. In South Arcot it is shown as Rs. 2-5-7. It is impossible to gather from the North Arcot statement the cost reduced to an acre of plantation, but the cost per acre of nursery is given as Rs. 140. The area this nursery is supposed to provide with plants is not given.

(d) *Cost per acre of planting.*—(i) *The cost of pitting* in Nellore and Tanjore amounted to 6 annas per 1,000 plants, in South Arcot to 6 annas per acre and in Trichinopoly is put down at Re. 1-1-6 per acre. There is ample scope for reduction in the last-named district. (ii) *the cost of planting out the seedlings* in Nellore and Tanjore was practically the same, 4 annas and 5 pies per acre. In South Arcot, inclusive of watering while planting, it amounted to one rupee per acre; the higher rate in this district compared with Nellore is due to the larger number of plants put out—1,210 per acre instead of 540. In Trichinopoly, however, the cost of planting out 1,200 seedlings is shown as Rs. 3-6-0 per acre. In future I think 9' x 9' may be adopted as a rule for the distance when planting, and the cost, I consider, should not exceed 6 annas.

(e) *Cost of watering* (i) *Wells.*—The cost of sinking wells varied from 4 annas per well in Nellore and Trichinopoly to 14 annas in Tanjore. This naturally depends upon the soil and the depth of the water level below the surface. The number of wells per acre ranged from three-fourths of a well per acre in Nellore to two in Tanjore. It is not advisable to stint the number of wells, their cost is trifling and it must be borne in mind the nearer the wells the greater the number of plants a cooly can water per diem. (ii) *Number of plants watered per diem by one cooly.*—In Nellore a cooly watered 1,000 plants per diem, giving each plant half of a large chatty. In Tanjore the same number

of plants was watered twice a day, each plant receiving two-thirds of a chatty. In South Arcot the number varied from 600 to 800 plants. In North Arcot a female cooly watered 150 to 200 plants, giving each plant one whole chatty, and in Trichinopoly only 135 plants. There is no doubt the figures in the last district do not represent a fair day's work, and there is no reason for the average being below that of other districts. With three wells to the acre a male cooly should water at least 600 plants per diem. (iii) *Length of time watered.*—In Nellore it was the practice to water the seedlings for four years. In the first year the plants were watered daily from time of putting out (September and October) until May after which the number of coolies employed depended upon the intensity of the south-west monsoon and the site of the plantation; on high sand banks daily watering was undertaken until the North-east monsoon. The second year watering was conducted from February to May and in August and September. The third year watering was confined to the months March to May and August and September, the same during the fourth year. The cost amounted to Rs. 41-14-4 per acre. In North Arcot it was the custom to water for three years throughout. In South Arcot, as a rule, plants were watered for six months in the first year, four or five in the second and occasionally during unfavourable seasons for some time in the third year. The cost for two years' watering amounted to Rs. 26. In Tanjore, plants have been watered for four months in the first year, eight in the second, six months in the third and two months in the fourth, and the cost has been Rs. 58 per acre. In Trichinopoly, watering was supposed to be carried on for eight months in the first year, six months in the second and three months in the third. The plants were only watered from four to six times per mensem, yet the cost of watering amounted to Rs. 96-2-6 per acre. It is certain that the watering charges in some of the districts were excessive and no reason can be assigned for the excess. I feel convinced that under ordinary circumstances, except in North Arcot, it is seldom necessary to water regularly for more than two years, though it may be found advisable to water parts of plantations during the third year. Even in North Arcot it is decidedly unnecessary to water regularly for the whole three years.

(f) *Establishments.*—In some districts the permanent establishment undertook the supervision of plantations, in others, temporary overseers were entertained. These charges cannot well be compared as they depend upon the strength and distribution of the permanent establishment.

(g) *Total cost per acre until the plantations are virtually left to themselves, exclusive of supervision charges.*—Nellore Rs. 42-14-0, North Arcot Rs. 45, South Arcot Rs. 32-6-0, Tanjore Rs. 68, Trichinopoly Rs. 108-11-6.

4. Since submission of these returns, in every district it has been found possible to reduce the cost of these plantations. The following appears to me an extreme estimate of the cost per acre of a plantation on sandy soil on which the seedlings are put out 9' x 9' or 540 plants per acre :—

						Rs.	A.	P.
Nursery charges	...	...	...	...	...	0	9	0
Pitting	...	...	...	...	...	0	6	0
Planting out	...	...	...	...	...	0	6	0
Wells	...	...	...	...	...	2	0	0

Watering.

First year—

Two months daily watering 600 plants per diem
at two annas per cooly $= \frac{540 \times 2 \times 2 \times 30}{600} =$

108 annas Rs. A. P.
... 6 12 0

Three months watering alternate days $= \frac{540}{600} \times$

$\frac{30}{2} \times \frac{3}{1} \times \frac{2}{1} = 81$ annas 5 1 0

Three months watering every third day $= \frac{540}{600} \times$

$\frac{30}{3} \times \frac{3}{1} \times \frac{2}{1} = 54$ annas 3 6 0

15 3 0

Second year—

Six months watering every third day $= \frac{540}{600} \times$

$\frac{30}{3} \times \frac{6}{1} \times \frac{2}{1} = 108$ annas 6 12 0

Third year—

Four months watering every third day $= \frac{540}{600} \times$

$\frac{30}{3} \times \frac{4}{1} \times \frac{2}{1} = 72$ annas 4 8 0

29 12 0

Add 10 per cent. for contingencies, or say ... 3 4 0

33 0 0

5. From previous experience it should be safe to estimate that a plantation, except in North Arcot, will yield after ten years 40 tons per acre. The revenue after deducting felling and removal charges will certainly amount to Rs. 3 per ton = Rs. 120

12 THE TEAK TRADE OF CHIENGMAI IN SIAM FOR 1894,

Deduct—

Cost of planting	...	...	...	...	Rs. 33
Interest at 5 per cent. for ten years, say	...				„ 16
Establishment charges, say 10 per cent. for ten years	„				33
					— 82
Total net revenue	...			R.	38

Or Rs. $3\frac{4}{5}$ per acre per annum.

In districts like North Arcot, the estimated outturn will probably not be realized ; on the other hand, however, it is certain the revenue will exceed Rs. 3 per ton and the net revenue should not fall below my estimate.

The Teak trade of Chiengmai in Siam for 1894.

The value of the teak exported exceeds that of all other exports from this district. The arrivals at Chainat in the year 1894 were about 71,500 logs. This, as compared with 69,500 logs in 1893, shows a slight increase of about 2,000 logs, and very nearly reaches the figures of 1892, as may be seen from the following table :—

Year.					Number of Logs.
1888	--	...	...	...	63,000
1889	...	...	...	...	60,000
1890	...	...	...	...	30,000
1891	...	...	...	...	12,000
1892	...	...	...	...	72,000
1893	...	...	...	...	69,500
1894	...	...	...	...	71,500

The floating season of 1894 was good in the Chiengmai Valley. There were several high rises and there was not the super-abundance of water of the year before, but in some streams the water rose little and the timber was not cleared out. In the Lakhon River the rise was a fair one. A good deal of the timber that reaches Chainat or Bangkok in the course of one year is timber that has floated to the main rivers during the year before, but has not succeeded in reaching the rafting stations.

The returns of exports to Lower Burma have not yet been received and as it is judged best not to delay any longer the transmission of this report they are not included in it. The season on the Salween is, however, reported to have been also good.

The teak forests on the Salween side have been worked longer than those in the Menam Valley, and far more actively, owing to the higher price of timber in Moulmein and the keener competition. The result is that those forests have been almost depleted of timber, such as there is left within Siamese territory being either small or far from the main streams; this is clearly shown by the increasing proportion of undersized timber that now goes down to Moulmein. The royalty is also double that on the eastern side. Under these conditions it is difficult to understand how those forests can be worked profitably unless the prices in Moulmein rule high.

The complaints of the foresters here on the small margin left for profit have continued during the year. Many good forests have been overworked, and the yield is now naturally smaller than in previous years; and, apart from this, the terms sought to be imposed by the Siamese Commissioner on new leases of forests were decidedly onerous. The result has been that foresters have held back in anticipation of more favourable terms. The whole subject of the form of lease has thereupon been discussed by the Siamese and British authorities, and a satisfactory settlement was expected at the end of the year. A table of the forest leases granted to British subjects and registered at the vice-consulate since 1884 is appended:—

Year.			Number of Leases.				
			For 2 Years.	For 3 Years.	For 6 Years.	For 9 Years.	For 10 Years.
1884	...	...	...	...	2	...	...
1885	...	...	...	4	16	...	...
1886	...	...	...	1	2	...	1
1887	...	...	...	...	4	...	...
1888	...	...	...	2	1	...	...
1889	...	...	...	2	...	...	...
1890	...	...	...	...	...	...	...
1891	...	...	...	3	...	1	...
1892	...	...	1	6	...	...	...
1893	...	...	...	3	...	...	...
1894	...	...	...	...	...	...	...
Total	...	...	1	21	25	1	1
							49

The lists shows that no leases were registered in H. B. M.'s Vice-Consulate during 1894, although the terms of a number of leases had expired. The foresters mostly confined themselves to working out timber felled within the terms of their leases. The leases shown in the above list comprise the greater portion of the forests in the provinces of Chiengmai and Lakhon. The remainder are worked by Siamese subjects almost entirely with British capital, so that the teak forest work and export business may be said

special works on Sylviculture and Forest Law, for a work to be published which pre-supposes a good knowledge of the elements of all these. We are unaware if at Coopers Hill, Forest Protection is taught as a special course or whether, as at Lehra Dun, it is treated under the heads of the more definite subjects to which its various chapters belong. However that may be, there can be no doubt but that Mr. Fisher has produced a very excellent work, and one that will be of very great value not only to the students of his own class at Coopers Hill, but also to all English and Indian Foresters, and to many of the landowners who grow forests for one purpose or another, and take an interest in the measures which should be adopted for their protection in one way or another. As is stated on the title page, the work is an adaptation from the German, from the work of Dr. Richard Hess, Professor of Forestry at Giessen entitled 'Der Forstschutz' and we are bound to say that we like it much better than the 'Waldschutz' of Dr. Kaushinger and Fürst which was translated by Dr. John Nisbet and published in 1893. Comparisons, they say, are odious, and we do not intend to make any between these two works of German authors, adopted and translated by Indian Forest Officers, except so far as to remark that one point of value about Mr. Fisher's work lies in the numerous excellent wood-cuts in the text, so much easier to consult than special plates at the end, as is the arrangement in Dr. Nisbet's book.

The work before us is divided into six parts, treating of protection of forest against (1) man, (2) animals, (3) plants, (4) atmospheric influences, (5) non-atmospheric natural phenomena and (6) certain diseases. It is prefaced by an 'Introduction' which defines that "Forest Protection has for its object the 'security of forests against unfavourable external influences as far as lies within the power of their owners' and shews how protection may be 'preventive' or 'remedial' and how the subject is connected with the other branches of Forestry and the sciences and subjects connected with it.

Under 'Protection against man' we are first given a clear and useful account of Demarcation, in which we seem to see traces of Mr. Fisher's old Indian experience, for the system advocated is very much what has been adopted in this country. There is one point, however, which Mr. Fisher should, we think, have made clearer, and that is the procedure, where, as so often happens in India, the Government has to demarcate forest land adjoining the states of jealous owners who do not participate in the work and its expense. In such cases the boundary ditches and rides and the marks themselves must be entirely on the side of the forest and such a plan as that of figure 2 at page 8, where the mark is partly on one side partly on another, would hardly do.

Then follows an account of protection against irregularities in utilization, such as over-felling, careless conversion, the removal of

been gradually decreasing, and this year very few have come westward. This is attributed to the French occupation of the Khamu country, and consequent enrolling of the hillmen for road-making and other public works. This reason, however, does not explain the decrease in previous years; and there can be little doubt that it is partly due to the difficulty experienced by many of these men in obtaining their just wages from unscrupulous or bankrupt foresters. Meanwhile, wages of such Khamus as are available have risen considerably. Formerly Khamus could be hired for 40 to 60 rs. a year and their food; now they cannot be had under 70 to 90 rs. a year. The foresters will before long have to content themselves with native labour, that is of Laos and Shans, which would be not more expensive but far inferior.

Joined to this labour difficulty is the growing scarcity of timber near the main rivers; so that where an elephant formerly could work out 60 to 70 logs a year, it can now only work out half that quantity. Foresters, therefore, now find they have to work under the disadvantage of an increase in the cost of coolie wages, higher fees, higher cost of provisions, and greater cost of working out timber. To compensate for this they can now obtain advances at 12 per cent. per annum, where they formerly had to pay from 24 to 60 per cent. The risk primarily falls on the exporters who advance the capital to the foresters; and the profits of the exporters are dependent on the London rates for teak. When these are low it would seem that the export of teak must be carried on at a loss. The foresters themselves reckon their net profits at 50 or 60 rs. a year for each elephant worked by them.

Appointment of a Conservator of Forests in Siam.

We are glad to be able to say, with reference to the last Article, that Mr. H. Slade, Deputy Conservator of Forests in Burma, has been deputed to Siam for the purpose of organizing a Forest Department in that country.

Schlich's *Manual of Forestry*.

VOL. IV. FOREST PROTECTION, BY W. R. FISHER, B. A.

"Forest Protection" is a new term to us, and we believe that in French also there are few, if any, works with such a title. It may be questioned indeed whether it is really justifiable, when we have no special works on Forest Utilization, Forest Engineering, Forest Zoology, and Forest Botany, and have only recently possessed

special works on Sylviculture and Forest Law, for a work to be published which pre-supposes a good knowledge of the elements of all these. We are unaware if at Coopers Hill, Forest Protection is taught as a special course or whether, as at Lehra Dun, it is treated under the heads of the more definite subjects to which its various chapters belong. However that may be, there can be no doubt but that Mr. Fisher has produced a very excellent work, and one that will be of very great value not only to the students of his own class at Coopers Hill, but also to all English and Indian Foresters, and to many of the landowners who grow forests for one purpose or another, and take an interest in the measures which should be adopted for their protection in one way or another. As is stated on the title page, the work is an adaptation from the German, from the work of Dr. Richard Hess, Professor of Forestry at Giessen entitled 'Der Forstschutz' and we are bound to say that we like it much better than the 'Waldschutz' of Dr. Kaushinger and Fürst which was translated by Dr. John Nisbet and published in 1893. Comparisons, they say, are odious, and we do not intend to make any between these two works of German authors, adopted and translated by Indian Forest Officers, except so far as to remark that one point of value about Mr. Fisher's work lies in the numerous excellent wood-cuts in the text, so much easier to consult than special plates at the end, as is the arrangement in Dr. Nisbet's book.

The work before us is divided into six parts, treating of protection of forest against (1) man, (2) animals, (3) plants, (4) atmospheric influences, (5) non-atmospheric natural phenomena and (6) certain diseases. It is prefaced by an 'Introduction which defines that "Forest Protection has for its object the 'security of forests against unfavourable external influences as far as lies within the power of their owners" and shews how protection may be 'preventive' or 'remedial' and how the subject is connected with the other branches of Forestry and the sciences and subjects connected with it.

Under 'Protection against man' we are first given a clear and useful account of Demarcation, in which we seem to see traces of Mr. Fisher's old Indian experience, for the system advocated is very much what has been adopted in this country. There is one point, however, which Mr. Fisher should, we think, have made clearer, and that is the procedure, where, as so often happens in India, the Government has to demarcate forest land adjoining the states of jealous owners who do not participate in the work and its expense. In such cases the boundary ditches and rides and the marks themselves must be entirely on the side of the forest and such a plan as that of figure 2 at page 8, where the mark is partly on one side partly on another, would hardly do.

Then follows an account of protection against irregularities in utilization, such as over-felling, careless conversion, the removal of

leaves and humus, and above all, badly regulated grazing. An interesting figure is given of the damage that may be done by climbing irons used in the collection of seed, or for the lopping of branches, and it is shown how careless transport may damage the trees of the forest. Under grazing it is interesting to note Hundeshagen's table of the relative damage done by European grazing animals, which, assuming the horse to be represented by 100, gives 75 for young cattle, 50 for old cattle, 25 for goats, and 29 for sheep. As a goat, however, weighs about one-fourteenth as much as a horse, it does therefore presumably $3\frac{1}{2}$ times as much harm.

We are glad to see that Dr. Hess and Mr. Fisher agree with us in the opinion we have always held as to the effect of constant grazing on unburnt grass areas being the gradual disappearance of the coarsest kinds of grass and the substitution of finer and more and more nutritious species. We have noticed this ourselves in many places in India and nowhere more clearly than on the Nilgiri Hills, and in some places in the North-Western Provinces, which could be pointed out.

The Chapter on 'Protection against Forest offences' has had the advantage of the unrivalled experience of Mr. B. H. Baden-Powell, C.I.E., who has himself written the pages on forest property and forest rights so as to make them agree with English Law. This is, in itself, a sufficient guarantee for their excellence.

On the subject of Part II 'Protection against animals,' we are glad to reproduce a short Note which has been written for us by a competent Indian authority, who says:—

Not the least interesting and useful portion of this work is that which deals with the animal foes of the forest. These, so far as European species are concerned, are very fully dealt with. We should like to point out, however, that though the first chapter of this section is rightly enough headed 'Protection against Animals' in the general sense, the same heading when confined to the tops of the pages dealing with the injuries inflicted by various *Mammalia* only, is out of place. The popular use of the general term "Animals" in the special sense of a Mammal or Beast, should not be countenanced in such a work. In this Chapter a slight error occurs, where it is stated that holes made by the woodpecker may be a source of harm if subsequently occupied by ring-doves. It is the stock-dove, not the ring-dove or wood-pigeon, which nests in holes, and this is fully recognized in the same connection later on (p. 131). For extra-European animals the reader is referred Mr. E. C. Cotes' work on Indian Forest Zoology.

Full details as to the damage inflicted by the various species of European deer follow, with the methods of obviating this, which are well worth the attention of foresters here. It is pointed out that the existence of a reasonable quantity of game is quite compatible with the interests of the forest. Pigs are better than deer, as they may be beneficial as well as injurious, by breaking

up the soil and destroying vermin. Reference is made to the *Indian Forester*, Vol. XI. p. 530 re a plan for catching them. Hares, rabbits, and other rodents not regarded as game, are dealt with, and the ravages of and remedies for various species of mice fully dealt with. Protection of their carnivorous enemies, both beasts and birds, is recommended, when these are not too destructive to game or useful birds. Birds, generally speaking, are to be considered useful, not many being selected as offenders to sylviculture. We must say we are somewhat astonished to see the Robin (*Erithacus rubecula*) set down, together with the Mealy Redpole and Bullfinch as a seed and bud-destroyer; whatever damage it may do in this way must be unworthy of notice, considering its solitary and generally insectivorous habits. We would also caution the Indian forester against dealing so severely with the Indian Jays as our author recommends in the case of the European species; the greater abundance of large insects in Indian forests gives these birds a greater chance of doing service, to set off their ill work in devouring seeds and useful birds. The case for and against woodpeckers is set forth in this chapter, and judgment given in the birds' favour. It is pointed out that all useful birds tend to keep down insects in normal years, though unable to avert a plague; such visitations are put an end to by fungoid diseases and parasites. In the next chapter, which contains an admirable general account of Forest insects, embodying concise and clear sections on classification, distribution, and the like, we find the subject of birds and other insect-enemies again taken up and directions given as to the provision of food and nesting places for the former, under the head of Preventive Rules. The following chapter deals with those enemies of insects which belong to their own class and is a particularly instructive and interesting one, all the important families being characterized and their benefits particularized. The injurious insects follow, taking up a larger space than all the preceding animals put together, and are treated very completely; family and specific descriptions are given, the relations of each species to the Forest discussed, and Protective Rules given, under clear headings; in fact, this convenient division of the subject-matter is one of the most striking features of the book. To the Indian forester the more general portions of this part of the work will naturally be of most value, and he should derive much instruction from the accounts of the many methods of protection given, while the family descriptions given will often be of service even when dealing with Indian insects—a remark which applies equally to the chapter on insect benefactors. A most useful list closes this part of the book, including all the injurious insects dealt with therein, arranged according to the species of tree attacked and the different organs of it which suffer, with other details indicated by abbreviations. This chapter concludes with an earnest injunction to the forester to study

forest insects ; their life history and relations to the forest must be known, and that not from books ; for "inattention to those little creatures has already in many cases been severely punished by the sacrifice of the labour of years." Once an insect attack has attained large dimensions man's efforts against it are almost powerless." If this be true in Europe how much more is it the case with India ! It, will be a happy day for the Indian Forester when a work similar to this can be published dealing with, this country.

The whole of this part has been gone over and revised by Mr. W. F. H. Blandford, lecturer on Entomology at Coopers Hill. It ends up with the valuable remark that "the most effective means for combating insect attacks consist in careful and cleanly forest management, and in repressing an attack at its very commencement."

Part III, 'Protection against Plants' has had the advantage of correction by Prof. Marshall Ward, F. R. S., now Professor of Botany at Cambridge University, and is a most interesting account of a subject which has only in recent years and chiefly through Prof. R. Hartig's researches, been developed as one of the most important ones which a Forest Officer has to deal with. To any one who knows where to notice them, evidences of damage by plants may be seen almost everywhere, not only in Europe but in India. If we are not mistaken, *Agaricus melleus* may be seen attacking oaks and conifers in the North-West Himalaya just as severely as it does the pines and spruce in Germany or the oaks of Capetown. Species of *Polyporus* may be seen doing very great damage in the plantations of Sissú at Changa-Manga and of Casuarina in Nellore. *Elcidia* of various kinds are common on the Himalayan trees of many species and especially on the blue pine, spruce and fir ; black *Meleola* covers the leaves of the sal trees in the Dún and in Oudh. Of phanerogamous parasites we have only too many, for in addition to the mistletoe of Europe, which is so common in places in the Himalaya, especially on apricot trees, we have numerous almost gigantic species of *Loranthus* devastating our forests and plantations as may be splendidly seen in the havoc it has wrought among Australian Acacias in the Nilgiri plantations of Bandy Shola. We have gone over Mr. Fisher's work with much interest, and in many ways prefer it to the more elaborate and detailed accounts given in the recently published edition of Hartig by Dr. Somerville. We commend the subject to Indian foresters as an almost new field, and look forward to the time when we shall have a good Indian book about it by a Forest Officer who has traced the diseases through all their stages and can suggest measures for their prevention. We would draw our readers' attention to Dr. J. Nisbet's article in our number for April, 1893 (Vol. XXI), as well as to the work done by the late Dr. Barclay, and published chiefly in the proceedings of the Asiatic Society of Bengal.

It is naturally the diseases caused by fungi, that take up the greater part of Mr. Fisher's, Part III, but excellent accounts are also given of the damage done by the parasites like the mistletoe and dodder, by climbers and by forest weeds, which prevent reproduction, impoverish the soil or produce a sour humus which is bad for the growth of most forest trees.

Part IV, 'Protection against atmospheric influences' begins with our great enemy in Northern India, the *frost*. It shews what gradations there are among forest trees in the matter of susceptibility and what are the localities in which frost is most to be feared, and gives suggestions for prevention. Among other interesting matters touched upon, we may draw attention to the series of pictures shewing the way in which frost acts upon young seedlings, gradually lifting them out of the ground until their roots lose their hold and the plants fall over and die. After 'frost' comes *insolation*, the effects of which are often very marked on isolated trees in the dryer regions of South India, where we have more than once seen every tree in a planted tope damaged irretrievably by the effect of the sun on its exposed side. Then come *storms, violent rain, snow, and ice*, all of which we know to be important and dangerous sources of damage to forests. We note that it is considered that woods which have been properly thinned are generally less liable to damage than unthinned woods, as the snow can more easily reach the ground and the wind can more effectually aid in shaking it off the branches of the trees in the canopy.

In Part V, the influences treated as 'non-atmospheric phenomena' are swamps, floods, and torrents, avalanches, shifting sands, and, last but not least, forest fires. The question of drainage is well discussed and some good suggestions, which may be of use in the Himalaya, are given in regard to works of protection against avalanches. No account of shifting sands in Europe would be complete without reference to the great works undertaken in France on the shores of the Bay of Biscay which are described. We note that on the German coast sods and in Flanders straw, are used to cover the ground in places in danger and protect young growth; while in South Russia the *Ailanthus glandulosa* has been grown successfully on Sand-dunes. This tree Mr. Fisher suggests, is a very accommodating species and should be tried in places on the Indian coast where the fresh water is too far from the surface to allow of *Casuarina* being grown. Noticeably also is the hint that the Jerusalem artichoke which is most easy of propagation, can be successfully used to shelter the young tree-growth, on shifting sands. The chapter on fire-protection has clearly borrowed somewhat from Indian experience, and gives a careful general account of the best measures of prevention to be adopted.

In the final Part VI., the 'certain diseases' discussed are chiefly the following: red-rot, white-rot, stag-headedness, abnormal

needle-shedding and damage by smoke. The causes of these diseases are explained and measure of treatment suggested.

We have now run over briefly the chief subjects treated in this excellent Manual, which ought to be in the hands of all Indian forest officers as a guide to and help in observation. Many a forest officer has, we dare say, however well-trained he may have been, asked himself what are the points which it is most important for him to observe as he goes through his daily routine in the huge forests he has to administer in India: as a help in answering the question, this work of Mr. Fisher's, and that previously published by Dr. Nisbet should be of great service.

It has, incorrectly, we believe, been said that 'there is no rose with a thorn' and it may be suggested that an appreciation of this excellent work may need some little thorn to show that we are not entirely partial. In the present case, the sting, like the scorpion's, must come at the tail, where lies the chief defect in the work and that is simply the absence of an Index. We know how often it happens that German and even French works suffer in value from the absence of an Index, but English books are usually free from the reproach and we hope that our friend Mr. Fisher, when he publishes his next edition, will remember our suggestion and give us a good Index to help us to utilize his abours to the best advantage.

Annual Forest Administration Report for Bengal, Coorg, and Berar for 1893-94.

The *Bengal* Report is written by Mr. A. E. Wild and is an interesting one ; the Local Government has, however, complained of its length, though it seems to us that the length is more apparent than real, as there are 40 pages of print rather larger than that in use in some other Provinces.

The area of forest under the Department in Bengal amounts to

	sq. m.	
Reserves	5831	} Total 12,924 square miles.
Protected	059	
Unclassed	4034	

We are sorry to see that the Sonthal forests have not yet been taken up ; and glad to notice that 363 acres of the Paglajhora catchment basin near Kurseong have been taken charge of to be treated in an attempt at reclamation. This is a work which has long been urgently wanted and we shall be glad to hear next year what steps have been taken to stop the torrents. It will not be an easy matter even with some expenditure, but simple closing and fencing will doubtless effect a great deal by themselves

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alone. Fire-Protection seems to have failed very seriously, especially in Singhbhum where 402,538 acres were burnt out of 468,322 whose protection was attempted. Very naturally, the Local Government have made some remarks on this and say :—

"The Lieutenant-Governor is surprised to learn that in Singhbhum no effectual attempt was made to check this enormous waste. Even if his aid was not invoked, the Deputy Commissioner should have brought offenders to justice if they could be identified, or failing that, he should have adopted other measures for the control of the population. His Honour observes that the Conservator has taken steps to keep himself informed of the occurrence of such cases and in view of the gravity of the circumstances disclosed, His Honour desires that until further orders a special report may be submitted to Government concerning every serious fire in a State Forest, as it occurs, showing how it originated and what measures were taken to punish the offenders. His Honour also approves of the Conservator's order that in respect of offences by fire, compensation should not be accepted under section 67 of the Forest Act."

The Government of India have approved of the orders given and especially of the one prohibiting the compounding of offences of incendiarism, which prohibition we fully agree is a proper policy. In an Appendix to the Report is given a note by Mr. H. H. Haines, Deputy Conservator, which we reproduce.

"Savannahs of greater or less extent occur in all the Jalpaiguri forests, and are of two kinds—

"1. Those on high land, which usually burn early in the season.

"2. Those in low land, which, will often not burn until the the hot weather.

"They first appear to have their origin in the thinning out of the tree growth by repeated fires, and they frequently pass gradually, on the one hand, into stocked forest without any sharp line of separation, and on the other hand into the low-lying grass land.

"It has been found that the firing of the first kind early in the season, and especially not long before the precipitation of dew, does comparatively little harm to the tree growth. The fall of the leaves of the trees of course takes place but these leaves have already nearly completed their work, and would soon fall naturally, and the previous annual shoots are seldom entirely burnt back. Seedling sál in the thicker grass is usually burnt back to the root, but very strong shoots which have sprung from root stocks, whose shoots have been burnt for several previous years, will survive where the grass thins off into the stocked forest. Thus, although the advance cannot be as quick as in the cases where fires can be excluded altogether, I am of opinion that the forest will very gradually advance upon the savannah,

‘Experience has shown that fires cannot be excluded altogether for several years successively, as incendiary fires cannot be entirely stopped. Incendiary fires usually take place from March to May and at any time of the day. The grass at this time is very dry. The new shoots of the *sál* (which have now sprouted) with the new crop of leaves is entirely destroyed, and the growth thus almost stopped for the year, while such fires will often kill outright *sál* saplings of several years’s growth. As incendiary fires, from their ready ignition, most commonly arise in savannahs, the advantage of departmental firing is obvious.

‘Where a savannah of the second type abuts on a *sál* forest it cannot usually be fired without the adjoining forest also becoming burnt. This forest is thus thinned out gradually at the edges, and a repetition of the fire annually will gradually give rise to a savannah of the first type on the high land. This probably explains the origin of the highland savannahs. To fire low land savannahs departmentally, therefore, requires first that a *pharé* should be cut around them, and that they should be fired from their edges all around. The advantage of this departmental firing prevents the extension of the savannah, but such blanks can never be themselves filled up, another advantage being that wholesale forest fires are made more difficult to produce. The results of departmental firing of savannahs are thus satisfactory and such firing is, I believe, at present the only practicable way of reducing the terrible damage hitherto done to these forests by fire.”

Mr. Haines perhaps does not know that the departmental burning of Savannahs (‘tappars’ in the N.-W. P.) is a common practice and a most important one, as enormously reducing the danger of fire in the more valuable forest adjoining. Also that it was regularly in force in Bengal from about 1880 for some years on the strong recommendations made by Sir D. Brandis. Such a forest as Muraghat, surrounded almost entirely by long grass tracts, and with pieces of savannah running in here and there ought to be very easy of protection in this way. In our opinion, the ‘lowland’ savannahs never will produce *sál* or indeed any other trees of value and ought to be under cultivation—the ‘high-land’ ones are probably mostly areas where *sál* will only grow with difficulty and of poor physique.

‘Grazing’ in Bengal is a subject, to judge by the returns, which need give but little anxiety to the forest officers, for after all, only 867 buffaloes, 1,094 cows and 403 goats grazed in the Northern Bengal 5 Divisions with a revenue of Rs. 7,138 or over Rs. 3 per head. The only District in which the grazing seems to be heavy is Puri where 9,900 animals grazed at full and 1,60,000 at privileged rates, the revenue being Rs. 4,661.

Under ‘Natural Reproduction,’ the most noticeable thing is the seeding and dying off of the bamboo in the Darjeeling Hills

"enabling the sál to gain ground in a successful manner." On this a Bengal forest officer of experience writes to us. "It is a pity that departmental operations are not undertaken to put the struggling young growth of sál in a favourable condition for developing before the bamboos reach their full size again. If set free from creepers and inferior growth of all sorts now, the proportion of sál would be fairly doubled, I think." In Burma, when a bamboo seeding year occurs, every means is at once taken to reap full advantage of it for the benefit of teak and we hope that something of the kind will also be undertaken in Darjeeling. The bamboo referred to is *Dendrocalamus Hamiltonii*.

We notice that the Japanese *Cryptomeria japonica* which is so successfully cultivated in the Daljeeling Hills, has begun to produce natural seedlings. The average girths of the *Cryptomeria* trees at Dhobijhora is given as 39 inches.

On the Extraction of forest produce, there is not much to notice, save that the working of the forests of Orissa for the East Coast Railway has been prevented by their great unhealthiness. It is also noticeable that the lease of 'Sabai' ('Bhabar'—*Ischaemum angustifolium*) grass from the Singhbhum forests was given for Rs. 3,000 instead of for Rs. 1,750 as last year. Mr. Wild gives the requirements of three out of the five Calcutta Paper Mills as 3,10,000 mds. and seems grieved that considering that the grass is valued at Rs. 1-7-0 per maund, the Government does not get a larger share in the profits. Perhaps, however, the cost of cutting over wide areas and of the freight of such a bulky article comes to more than the Rs. 1-2 which he estimates. If not, it is surprising that the leases do not attract greater competition.

The 'Financial results' of the year were —

Forest year	}	Revenue	...	...	7,73,096
		Expenditure	...	...	3,98,389
		Surplus	...	...	3,74,707
Financial year	}	Revenue	...	...	8,01,611
		Expenditure	...	...	4,04,043
		Surplus	...	...	3,97,568

The Coorg Report has not much of great interest, though there are a few things which deserve notice. In our last issue (December 1895) we discussed the question of *Lantana* which Mr. Prevost calls the 'Forester's friend.'

Noticeable is the account of the systems under which Sandal has been and to is to be exploited. On this the Deputy Conservator says :—

"During the year, 185 tons of sandal were collected at an average cost of Rs. 35-7-11 per ton against Rs. 30-5-3

per ton in the previous year. The average cost of collection for the past 10 years was Rs. 31 per ton. The selling price per ton was Rs. 417-10-11 against Rs. 448-8-0 in 1892-93. I trust by the new system of departmental collection lately introduced, to reduce this expenditure to Rs. 28 per ton, and at the same time bring in a superior class of sandal. The old system of collecting sandal was to uproot only such trees as were absolutely dead; over-mature or half-dead trees were left to still further decay, and the subordinates entrusted with the work, did not judge a tree by the state of its trunk, but were entirely guided by the appearance of the leaves, and if they showed the least signs of vitality, the tree was considered green, and was not marked for uprooting. This method of selection was not sound; once a sandal has matured, decay rapidly ensues, and at all periods of its existence it is most susceptible to any injury to its bark and roots, and it is rare to find any tree over fifteen years of age, entirely sound, and free from rot, &c. Instead of obtaining the full possibility from matured trees, these injured and half-decayed trees were left to struggle on until they were entirely dead, and then when brought to kotri were found to possess no billets, were hollow, and cracked, difficult to work up, and the quantity of heartwood had materially diminished."

Under the present system, a trustworthy Ranger is allowed to mark for removal those trees which are entirely dead, but the marking of over-mature and hollow trees which though not really dead ought for sylvicultural reasons to be removed, is done solely by the Deputy Conservator. Certain tracts of country are systematically worked over, and at the same time sandal seed is freely scattered in all likely localities. By this method every green sandal tree in the country comes under personal supervision; all cases of illicit damage can be at once detected; villagers warned to protect the trees, and not to injure them when burning the lantana surrounding their fields, and the progress of natural seedlings, results of broad-cast sowings, dibbling in, and other works of utility generally observed and noted. The quantity and quality of sandal obtained from these over-mature, but not actually dead trees, is greatly superior to that formerly obtained from those entirely dead, and it is absolutely certain that under the present system a greater possibility per tree is realized. Great attention has also been paid to the thorough extraction of all roots, as they contain a very large proportion of essential oil, and command high prices at the annual sales."

The financial results for the forest year were :—

Revenue	Rs. 1,75,991
Expenditure	„ 90,546
Surplus	„ <u>85,045</u>

26 REPORT ON THE HORTICULTURAL GARDEN LUCKNOW FOR 1894-95.

In the *Berar* Report also there is little for us to specially notice. As with Coorg, the *Lantana* question has already received treatment in our pages.

The Financial results for the Forest year were :—

Revenue	Rs. 4,79,475
Expenditure	„ 2,64,318
Surplus	„ 2,15,157

Forest Administration in South Australia, 1894-95.

Our review of the South Australian Forest Report for 1893-94, appeared at page 239 of Vol. XX. (June 1895) and we pointed out then, as indeed we had done on previous occasions how unsatisfactory it was as a record of real Forest work. The Reserves cover 215,696 acres but of this apparently only 11,881 acres are under any sort of management. What happens in the rest is no more apparent from the Report of 1894-95, than it was from that of 1893-94. The Revenue was £3,709, the expenditure £7,342, or a deficit of £3,643, which is one-half of the expenditure. What advantage the Department has been to the Colony except for the plantations, of which there is so little information that we are quite in the dark, it is difficult for outsiders to understand. The natural forests are apparently let out on lease for the cutting of timber, for grazing and cultivation.

The chief good work done by the Department seems to be the distribution (gratis?) of trees and vines, for no less than about 300,000 of each were distributed during the year.

Report on the Horticultural Garden, Lucknow,
for 1894-95.

This Report is unfortunately scarcely more than a record of disaster. In the autumn of 1894, a high flood in the Gumti River submerged part of the garden and much damage was done in all departments of the garden's work. In the Arboricultural section, the nursery was submerged for a week, so that out of 19,000 plants on hand at the beginning, barely 3,500 were alive at the end of the year.

It is not improbable that the low site of the garden is responsible for the ill success of the edible date which seems to perish unaccountably in spite of all care. The introduction of the Persimmon trees has not been very successful so far, but we are glad to say that they have done better in Dehra Dun with the

advantage of being tended by that successful and enthusiastic fruit culturist, Mr. Angus Campbell. The list of trees cultivated in the Nursery is a large one, but it is a pity that only native names should be given : even to a Forest Officer 'Shahtooth,' 'Momseri,' 'Chilwal,' 'Macluria,' 'Kankohar' and 'Kanyei' are rather terrible.

The plantation of the beautiful *Eucalyptus citriodora*, the prettiest of the genus, to our mind, is apparently a great success ; we should have liked to hear more about it.

The garden has been trying to do good work in educating native and European gardeners, but its success has been rather poor, for the two Europeans were failures, and of the natives, three left and two were dismissed for misconduct. This is a great pity, for there seems to be a considerable demand for good trained men.

V-SHIKAR AND TRAVEL.

The Mongoose in the West Indies.

Some years ago the Cane Fields in the North of the Spanish Colony of Puerto Rico were so much ravaged by rats, that Planters had recourse to the Mongoose, or Munguz. Four pairs were introduced from Jamaica. They multiplied with great rapidity, and in a very short time rats had practically disappeared; I myself have seen them by dozens drowned in the canals intersecting the Estate, driven apparently to take to the water to escape their relentless foes. Revisiting the Island after an interval of two years, I found the Mongoose established as an institution, infesting poultry yards, over-running houses, and often being made a domestic pet. The Canes were saved from one pest but at what cost the accompanying cutting from the "Field" of 13th July, describing the effect in Jamaica, will set forth. If any of your readers have the idea of introducing the animal to exterminate rats, the evidence of V. should make them reflect before they do so.—(F. N. in *Révue Agricole* of Mauritius).

The mongoose was introduced into the West Indies for the ostensible purpose of destroying the large grey white-bellied rat that played havoc with the growing canes on the sugar-growing plantations. That it fairly achieved the object for which it was imported cannot be gainsaid, but that it would ever become the universal pest that it is at the present day, and has been for the last ten years, was never anticipated. So long as it kept to the cane-growing plantations and ate the planters' poultry, eggs, and all young and available animal life within a reasonable distance, all went well; but with its rapid and prolific powers of reproduction and its vagabond and roaming disposition, it in very short time—a few years—was to be found in every part of the islands, from the sea shore to the tops of the loftiest range of mountains, the highest peak of which is 7,360 ft. above sea level.

I have had a long and intimate acquaintance with the mongoose, that is, since its first introduction nearly a quarter of a century ago. A few years ago attention was directed in a pamphlet on agricultural matters to the mongoose, its greatly increased numbers, its distribution and the devastation it was accomplishing, not only to young animal life alone, but to vegetation in the island of Jamaica. This pamphlet brought letters from all parts of the island, all of which complained most bitterly of the mongoose and the damage it was causing everywhere. The general wail had the desired effect, and a commission was appointed by the local government to inquire into and report upon the ubiquitous pest, *Herpestes ichneumon*. Very many gentlemen were called and gave evidence, and with one solitary exception—a cane cultivator and sugar boiler—their voices were raised against this new and introduced pest.

The mongoose, as I have said, was introduced to destroy the cane rat. Though it has not exterminated these rats, it has lessened their numbers in the canefields, and saved the sugar-planters a lot of money. It was not introduced to destroy, but it has most effectually nearly exterminated, all the ground-laying and feeding birds, poultry, eggs of all kinds, on the ground and in trees, including those of the land turtle; it kills young pigs, lambs, and kids; eats fruits of all kinds, canes, ground provisions, fish, wild-fowl, snakes, lizards, crabs, etc. All young and tender life, animal and vegetable, is included in its daily menu.

It has been said that the mongoose does not climb, and that he is only a day forager. Neither assertion is correct, for the animal will climb into a tree that would try the agility and pluck of a young descendant of Ethiopia, and during the beautiful moonlight nights that one experiences in the tropics, the mongoose will take his walks abroad intent on destruction of some kind. When up a tree he will destroy eggs or young birds in the nest, or eat the fruit that may be ripe. He does not kill the domestic or dark-furred rat, and I am aware of an instance in which a mongoose

and two of these rats found a common home or lodging-place in the trunk of a fallen tree. This, however, must be regarded as an exceptional case.

In Jamaica, there was a beautiful and indigenous snake, a friend to the agriculturist, *Chilobotrus inornatus*, commonly called the yellow snake, and growing to a length of six or seven feet. It is gone; love or money cannot procure a specimen, although I have been trying for the last five or six years to obtain one for a friend. Another ally of the land cultivator, the ground-lizard (*Ameiva dorsalis*), is gone, or is very rarely seen now, though formerly there were hundreds.

When he has cleared off the animal life and the fruit in a district, the mongoose turns his attention to the ground provisions, and here again he shows the variety of his tastes and the power of his jaws. He will grovel away with his paws until he lays bare yams, cocoas (*Alocasia*), sweet potatoes, cassava, bitter and sweet (the former, *Manihot utilissima*, poisonous in its raw and unprepared state), and other ground food bulbs. Of fruit, he has a partiality for the banana, the various ananas, the mango, and others, as well as for some of the tree vegetables, for instance, the delicious akee (*Cupania edulis*) and pear. The mongoose will likewise, when the irrigation canals are drawn off for cleaning, seize fish and make off with them.

Not the least harm it has done has been the destruction of insectivorous birds and lizards, and the consequent increase of another nuisance, the tick. This is a subject that the West Indian Government is bound to take up in the near future, and there is, or will be, found only one remedy, the introduction, propagation, and protection of insect-eating birds, and here I may mention that the West Indian mongoose would be most gratefully exchanged for the English sparrow.

The mongoose breeds about six to eight times a year, and I have never known of more than five young at each time; but upon this point opinions differ, one eminent local doctor of medicine (and a naturalist) stated before the Commission that the young numbered ten to eleven. The mongoose lives in the hollow of dead trees, dry walls, and other such places. His activity is wonderful, and it is a treat to see him leap at and secure a young fowl; he very seldom misses the quarry, which, when secured, he proceeds to mutilate in the groin, first of all drinking the warm blood, then devouring the liver, &c. With all his activity and pluck, however, he is no match against a good terrier, and those who wish to rear a few chickens must and do keep one or two of these dogs. The mongoose is cunning and sagacious; in fact, he is highly educated. I have seen one abstract an egg from a hen's nest, take it up with the forepaws, hug it to its heart,

and walk off on its hind legs. Here is an instance in proof of its intelligence and reasoning power. The narrative comes to me first hand from a gentleman holding the commission of the peace and not given to romancing. My friend, who is the owner of one of the principal coastal wharves in Jamaica and his own wharfinger, told me that his premises are overrun with mongooses, against which he wages perpetual war. He had noticed for a considerable time, as he sat in his office, an old buck constantly travelling to and fro between a log wood heap and the large warehouses. His constant perambulations had worn a distinct tract on the sandy soil. Afraid to have recourse to his gun in such a place, he provided a new spring trap, upon the lever platform of which he tied, as well as he could, an egg, and when the employé had drawn off for the midday meal he excavated a hole on the track, placed therein the trap, which he covered over with loose sand, leaving only the egg exposed, and, after making all smooth, retired to his office to watch. Ere long out came the mongoose and commenced a series of manœuvres as comical as they were cunning. After reconnoitring by some half dozen circular evolutions, he gradually approached the egg, and with his forepaws commenced to scratch the sand away about six or seven inches from the egg. A part of the trap soon became exposed, when a few runs round doubtless expressed his satisfaction at outwitting the wharfinger. The excavating and circular perambulations continued until the trap was undermined on the one side, when, losing its equilibrium, it fell into the miniature pit; the egg rolled off, and was immediately carried away by the intelligent but destructive animal.

The mongoose nevertheless is easily trapped, and it is a strange circumstance connected with its capture that very few females are taken or killed, perhaps one in twenty. This would lead to the conclusion that either the males are greatly in excess of the females or that the latter stay more at home to superintend domestic arrangements.

However interesting the mongoose may be from a natural history point of view, the fact remains that it has overrun every part of the West Indies, has done, and is doing, incalculable damage in every direction.

The question may be asked, "Is it not possible to exterminate it?" The answer is in the negative. On the plains and in cultivated districts it may be partially kept down; in the hills, in the rocky, inaccessible and uncultivated districts, never. Here it is, and here it is likely to remain.

The preserving of Wood, an Improved Process.

There has just been introduced into England by Colonel Haskin, an American gentleman, a process which bids fair to quite revolutionise the method now in use of preparing wood for buildings, railway and other purposes. Formerly our method of seasoning the material has been by the extracting of the sap either by the natural process of dessication by time and exposure to the atmosphere, or by artificial means, such as kiln drying, steaming, washing &c., but as Bessemer reversed the then existing treatment in the making of steel, so Colonel Haskin has reversed the mode of seasoning wood. On Monday at 2, Dean's Yard, Westminster, the offices of the company, an opportunity was afforded a large company, of inspecting numerous specimens of material which have undergone what has been termed the "vulcanising" process, and having described to them the means whereby wood of all kinds can be made lasting and durable in a comparatively short space of time. The main principle of the Haskin system, as differing from the processes of Keyan, Burnett and Bethel, is that to effectually preserve timber is to so treat the sap within the pores of the wood that the whole of its life-preserving properties are retained and solidified within the substance

itself. It has been shown that by burning or charring timber, as was done in olden times, the liquid matter near the surface was arrested by fermentation, therefore the inference drawn by the inventor of the new process is that if heat were put to the centre, the core of the stick, the entire body would be entirely preserved. The wood, it was pointed out, may be taken in its green state, and the various compounds then in the sap are by great heat and air-pressure distilled and retained within the wood without losing their antiseptic and preservative properties. The process is simply the passing of the wood through a cylinder 6½ ft. in diameter, the length of the tank being 112 ft. There it is subjected to compressed air for a length of time, and to a high temperature of from three to five hundred degrees, care being taken not to permit of the evaporation of the substances. By this means all the albuminous, glutinous, resinous, and oleaginous compounds become coagulated in the pores of the wood, and impregnate the whole substance. It is claimed that the high heat to which the wood is subjected does not affect the fibre and impair its strength; rather the reverse, for so long as the moisture is absorbed in the wood the fibre does not feel the heat. It was stated by the Colonel that the principal cost was that of the labour of getting the timber piled upon the trucks and run into the cylinder. The fuel necessary for raising the heat runs from 8 to 10 tons per twenty-four hours for 20,000 cubic feet of timber. As to the expense, Colonel Haskin stated that his process was much cheaper than even that of creosoting. The Colonel, while describing his system, referred in graceful terms to the efforts made by English scientists in the direction of wood-preserving. A number of cheap wood railway sleepers which has been exposed to the severest of weather and the heaviest of traffic for over ten years on New York and Boston railways were shown in a splendid state of preservation, and which, when the "bit" was applied, exhibited an interior of remarkable freshness. There were also on view some beautiful American woods of very close grain, and which, it was explained, were, after the vulcanising process, easily planed and tooled by the workmen. Judging from the exhibition at Dean's Yard, and the general opinion expressed at the inspection, there seems every prospect of a great future in this country for this improved process of wood preserving.—*Railway News*.

The Preservation of Timber.

Colonel S. E. Haskin has contributed an able letter on the preservation of wood to the columns of a technical contemporary, in the course of which he explains the process with which his name is identified in the following terms ;—

"Haskinsing, vulcanising," consists in placing raw wood in a cylindrical chamber made of boiler plate, of any size, or numbers of them placed together, according to the put-out required daily, and submitting the same for a few hours to a medium of superheated, circulating, compressed air, making as many as three or four charges per day of twenty-four hours, the effect of which is to destroy all germs inherent in the sap, at the same time developing the antiseptics and preservatives contained in the wood, which, by the air pressure employed, are prevented from escaping, and in cooling down under the same pressure as is employed in producing them they became fixed in the wood.

Will you kindly allow the following endorsements to appear in connection with my explanation :—

Mr. C. F. Chandler, Ph.D., of the School of Mines, Columbia College, New York, says :—"I have examined the sample of oakwood preserved by your process, which you placed in my hands. I find that it is entirely different from the original wood, of which I also examined a sample. The treatment to which the wood has been exposed has effected a radical chemical change in its character, and it now contains 11.91 per cent. of materials, most of which have resulted from the action of heat. These I have succeeded in separating into : Neutral oils, turpines, &c., 0.36 per cent.; resinous acids and other bodies, 10.78 per cent. a very considerable portion of this 11.91 per cent. of material consists of antiseptics and preservative substances, which will act to protect the wood from decomposition and decay. They have also radically changed the appearance of the wood, producing what would otherwise have required a long lapse of time. The wood before treatment does not contain the above-mentioned substances, and would be liable to be attacked by microscopic fungi, and to undergo decay when exposed to air and moisture. In conclusion, I will say that your process seems to be a remarkably simple and effective one for improving the appearance and very greatly increasing the durability of timber, and protecting it from the agencies which result in destroying by decay timber which has not been treated.

Mr. R. H. Sloan, Chief Engineer, Manhattan Railway, tells me in reply to my inquiries as to the life of my cross-ties and planking which had been treated by the vulcanising process, timber so treated six years ago "is sound, and the surface of the ties and planking vary hard. There are no indications of decay at the end of those planks which were vulcanised, while the planks not treated and placed on the structure about the same time are decayed at the ends, or where they are nailed to the supporting timbers.— I am inclined to think the process of vulcanising will soon be found to be the best way of preserving timber."

Distillations of wood are obtained, one after another, according to the degree of heat and vacuo employed. On Mont Blanc, at some seasons of the year, ebullition, or boiling of water, will take place,

and the water evaporate, whilst it is not hot enough to cook ordinary vegetables. The air pressure being so much less at that altitude than 15lb to the square inch, the ebullition occurs for want of air pressure. The air pressure used in my process prevents ebullition, consequently a greater heat can be applied to the wood without causing destructive distillation or in any way injuring the fibre.

When the tree has been separated from its roots, the sap still contains the principle of vegetation, which by certain influences are brought into activity, causing every species of decay. This *vis vitæ* is the albumen in the sap.

The albumen in the sap of wood often produces a thread-like growth found in railway sleepers, extending throughout and terminating frequently at the end of the timber in a fungus formation. This mycelium destroys the vitality of wood. A good example of its growth I found near Manchester in some timbers which had been creosoted and used for railway sleepers, and afterwards taken out from under the rails and made into a fence at a crossing by placing the timbers on end close together.

A portion of the surface of the sleeper broken away, revealing the threads of mycelium interlaced in a perfect network following the course of the cells and ducts of the wood, which, except as to a thin surface, where the creosote had penetrated, was completely rotted.

By my process of conserving timber, the vegetating or life-giving principle of the sap is destroyed by the great heat to which the wood is subjected. An experience of ages has shown beyond all question that "charring" wood will preserve it from decay; so far as the heat penetrates beyond the flame line it will invariably be found sound, firm, and strong, for the reason that the vegetating principle in the sap has been destroyed, but in charring, the heat cannot penetrate to the centre of the timber without burning too deeply, hence the circle around charred fence posts and timbers remains perfectly sound, while the centre has rotted away, whilst in my process the heat is made to the very centre and the fluids are so held confined by pressure that none of them can escape the action of the heat.—(*Timber Trades Journal*.)

A Norwegian House in England.

Writing in the *American Architect*, Mr. A. T. Sibbald says:—
A friend of mine in Devonshire, England, being compelled in the course of last year to build a house, and finding that the estimates submitted to him for plans of the usual kind exceeded what he was willing to spend, he thought him of what he had seen of houses in Norway. An application to an architect in Christiania brought him several plans, one of which happened to be a plan of a house in Bergen, which he had inspected and admired. This plan, after a few modifications had been made in it, was adopted.

An estimate and specifications were then obtained from a builder in Christiania, who undertook to erect the framework of the house, to pull it down, and to deliver the materials duly numbered and prepared for transport and reconstruction alongside a ship which the purchaser was to charter. The order for the house was sent in January, and within three months it was ready for transport. Some delay was incurred in getting a vessel, and it did not leave Christiania till May 18th. A tedious voyage further delayed its arrival in England till the same time in June. It was then conveyed by railway to its destination, and on June 28th the work of re-erecting it was begun. Early in the month of December it was ready for occupation, though, owing to the dampness of the Devonshire climate, it was found expedient to delay until the spring the putting on of the outer shell.

While the house was in course of construction at Christiania, certain necessary works of preparation had been going on in England. The cellars had been made in the usual way, a stone wall on which the wooden structure was to rest, rising about 4 ft. from the ground, was built, and the brick flues of the house had been in part erected.

The walls are made of pinewood about 6 in. thick, the interstices of the logs being filled with oakum, and the whole surface being plastered with a mixture of cow-hair and lime. Outside the main wall there is a shell of wood, which is protected with paint against the action of the weather, and again inside there is another shell, which serves as a panelling to the rooms. By staining and varnishing this a good effect is produced. The cornices are carved by the use of the ricand saw in devices of excellent taste. It should be noted that neither paper for the walls nor plaster for the ceiling is used throughout the house. It is important to observe that everywhere the logs of timber are placed vertically, an arrangement which adds somewhat to the expense of the building, but which, as the contraction of the wood in drying is not lateral but vertical, prevents the unevenness so often to be observed in the woodwork of English houses.

To avoid the resonance which might be expected in a house so constructed, dry sand to the depth of four inches is placed between the ceiling of the cellars and floors of the ground rooms and again between the ceilings of these and the floors of the rooms above. In addition to this, the floors of both stories of the house are laid with deals two inches thick, a millboard being placed under each, with the effect of thoroughly deadening all sound.

The house, which presents externally the appearance of a handsome villa residence, brighter, indeed, in colour than we commonly see in England, is an oblong of about 74 ft. by 56 ft. On the ground floor, besides the kitchen with its offices, butler's pantry, front and inner hall, there are these principal rooms:—Drawing room, 29 ft. by 16 ft.; second drawing-room, 24 ft. by 16 ft.; library, 16 ft. by 12 ft.; dining-room, 24 ft. by 20 ft.;

business-room, 16 ft. by 14 ft.; ante-room, 12 ft. by 12. All the rooms on this floor are 13 ft. in height. On the first floor, which is 10 ft. 6 in. in height, there are : - Day nursery, 26 ft. by 13 ft.; night nursery, 13 ft. by 12 ft. 6 in.; bath-room, 15 ft. 6 in. by 13 ft. 6 in.; bedroom, 24 ft. by 21 ft.; ditto, 24 ft. by 21 ft.; ditto, 21 ft. by 15 ft.; ditto, 15 ft. by 14.; ditto, 15 ft. by 13 ft.; ditto, 22 ft. by 11 ft. All these are furnished with stoves. There are also two wardrobe-rooms, each measuring 15 ft. by 13 ft., one of which has a stove, and may be used as a bedroom, and linen-room 14 ft. by 7 ft. It may be observed that there is room and opportunity for constructing attics in the roof, an addition which may be more easily made owing to the circumstance that the slates are laid not on laths and battens, but on panelled wood.

Now as to the cost. The stone foundation-wall cost 300 dols.; the builders' estimate, including sixteen stoves, doors, window-frames, door-handles, locks and other fittings, amounted to 4,385 dols.; the sea-freight was 1,020 dols., to which something must be added for carriage by railway; a fee of 560 dols. was paid to the architect, and to these sums must be added the cost of window-glass, slates, &c. The total cost will be something under 10,000 dols. The estimates previously obtained for a stone house containing about the same amount of accommodation had reached the sum of 23,000 dols.; extras, an important item in building expenses, not being included in the amount.

Probably the first question which every reader will ask is this : "But will not a house of wood be especially liable to fire?" That houses of wood generally are so liable is certain, but it is possible that proper precautions taken in their construction and management may very materially reduce the risk. A practical proof that some such result may be attained is found on comparing the Norwegian with the English charge for fire insurance. In England, the rate of an ordinary risk is 1s. 6d. per cent.; in Norway, it is one dol. (4s. 6d.) per thousand dols., or 2s. per cent.; an excess not indicating a much greater damage, and, in fact, easily to be accounted for by the smaller amount of business transacted by the Norwegian fire offices. One fertile source of danger is removed by the total separation between the flues and the rest of the building. That common cause of fire, the beam heated by too close proximity to a fireplace, cannot exist in a house constructed as has been described above. Safety is also provided for by the substitution of stoves for the grates commonly used in England. When we speak of stoves, however, it must not be imagined that the Norsk stoves are of the kind called the "close" stove. In the principal sitting-rooms they use them so constructed as to allow the luxury, which nothing but sheer necessity will make an Englishman relinquish, of an open fire. At the same time, it is evident that such a house having once taken fire would burn very rapidly and would be completely destroyed. It

would be wise to provide ready means of escape for the inmates. Another obvious precaution would be not to raise such a house to any great height, or certainly not use as a sleeping room any chamber that might be constructed above the first floor.

Doubts about the durability of such a structure may be more satisfactorily disposed of. The climate of Norway may be supposed to be more trying than that of England to wooden buildings. Not only are there greater varieties of temperature, but the average rainfall is higher than in England. At Bergen, for instance, the average is 89 in.—more, certainly, than falls in any English town. Yet, as a matter of fact, wooden erections of considerable antiquity are not uncommon in the country. Dwelling-houses may frequently be seen there which, though very old, appear as sound as when they were first erected, and it is certainly true that whether old or new they do not need the incessant repair which in England so considerably increases the total of a householder's rent. But whatever may be the age of Norwegian dwelling houses—in England there are few which are as much as two centuries old, and of these a considerable proportion are of wood—the churches afford incontestable proof of the durability of wooden buildings. The church at Hittedal—to mention two only out of the many instances which might be cited—was built in 1,800, and that of Fortundal is said to be eight hundred years old. These figures may possibly be exaggerated, but there are certainly gigantic pieces of timber in this structure whose history may be traced back for many centuries. These timbers are in the interior of the church, they are not painted, and they appear as fresh as if they had been cut down a year or two ago, no trace of worm or dry-rot being observable in them.

To sum up. It seems that an English purchaser can import a house from Norway for something less than half the sum which it would cost to build one in England in the usual way. It appears, also, that this house may easily be made of handsome appearance, both within and without, wood being more susceptible than either stone or brick of an ornamentation which is at once tasteful and cheap: that it will be somewhat less liable to fire, but pretty certain should fire once lay hold of it to be rapidly and totally consumed; that it will be cleaner, will need less repair and will in all probability be equally durable.—(*Timber Trade Journal*.)

The Forests of British Malaya.

According to a recent report of the United States Consul-General at Singapore, in the dense jungles that still cover a vast portion of the Malay Peninsula and the adjacent islands there exist many rare and valuable forest trees indigenous and peculiar

to this region. Of these the nine best known lumber-yielding varieties are the following :—

Seriah (Hopea).—This is a tall, handsome tree, with wood of a light-red colour, resembling coarse cedar in grain, much used in house-building for joinery work, but not suitable for beams and joists.

Mercanti.—An inferior variety of the preceding.

Telutong (Dyera costulata).—This is a large tree with soft, white wood, used for models, cases, and work where strength and durability are not essential.

Darrou (Sideroxylon sundaicum).—A heavy, close-grained wood, resinous and aromatic, which, though well adapted to carpenters' work, does not resist exposure to the weather sufficiently well to admit for being used to advantage in external constructions.

Balan (not scientifically determined).—A fine, large forest tree, 60 to 100 ft. in height, and 3 to 6 ft. in diameter, with hard, heavy, close-grained, tenacious wood of a light-brown colour, much used for joists and beams, and for all purposes where strength and durability are required.

Tampinis (Sloetia Sideroxylon).—A close-grained wood of rich brown colour, susceptible of a high polish, and closely resembling mahogany; most highly prized for joinery and building purposes on account both of its great durability and of the fact that it is not affected, as are other woods, by the ravages of the white ant, so destructive to timber in these latitudes.

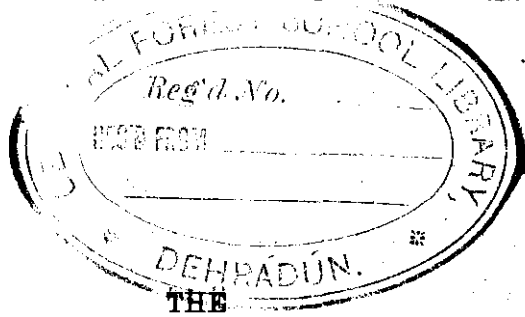
Karangie (Dialium indicum).—A tall handsome tree, often found growing to a height of 60 ft., with a diameter of 4 ft. Its wood is hard, dark-coloured, durable, and often finely grained. It is used for furniture, and to a certain extent, for building purposes.

Damarlant (Canarium sp.).—One of the great Malayan forest trees, especially plentiful in the neighbourhood of Penang, where it is much used for housebuilding. Its wood is light-coloured, close-grained, and lustrous, and is admirably suited for beams and joists, on account of its great transverse strength and stiffness.

Mirabou (Afzelia palembanica).—A large, majestic, leguminous forest tree, with tough durable, beautifully-grained wood, susceptible of a fine polish, and well adapted to furniture making.

The kinds most extensively handled as lumber in the Singapore market, and the prices per ton of 50 cubic feet, are the following, the prices being quoted in Mexican dollars :—*Seriah* 14 to 25; *Mirabou*, 30 to 45; *Telutong*, 15 to 20; *Darrou*, 20 to 25; *Balan*, 25 to 35.

In addition, there is a considerable amount of teakwood imported into Singapore, mainly from Burmah and Siam, which commands on the spot from 40 dols. to 65 dols. (Mexican) per ton. (*ibid.*)



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An Injurious Insect in Jodhpur.

Under the above heading, Pandit Gokal Das, Supt. of Forests, Jodhpur, in the October Number (1895) of the *Indian Forester*, asked for suggestions as to the methods to be employed in the destruction of a locust-like insect reported to be attacking a plantation of young mango trees. The insect in question was forwarded by him to the Entomological Department of the Indian Museum, Calcutta, for identification and for suggestions as to means to be taken for its destruction. It was identified by the Deputy Superintendent as *Pylotropidius didymus*, an Orthopterous insect of the family *Acrididæ*. He apparently made no suggestion as to means for destroying it, but mentioned that the insect had not previously been reported as destructive to agriculture. As any new attack from an insect previously unrecorded as a pest is of interest and more especially so in this case when it is the life of a young plantation that is at stake, I wrote to Pandit Gokal Das asking him if no other insects were to be seen on the mango trees at the time of the attack by the locusts and also as to date of his letter to the Superintendent, &c. My reason for these questions was that I thought damage might be due to one or other of the two Heterocera, *Nutada velutina*, Kollar, a Limacodidae or *Artaxa limbata*, Butler, of the family Liparidæ which both attack the foliage of the mango. In answer, the Pandit stated that no other insects appeared to be attacking the trees except occasionally white ants. He very kindly forwarded me at the same time some specimens of *P. didymus* and some young mango plants which were said to have been killed by the insect. Some of the Sangtra plant was also received, which is stated to be growing amongst the mango and to be unattacked. A cursory examination of the stems of the mango trees showed me that the damage was not due to the work of White Ants. The damage was first noticed about the second week in May and the letter to the Superintendent at the Calcutta Museum was written on May 23rd.

These dates are important as helping to give colour to the statement that *P. didymus* is the aggressor.

Acrididae mostly hibernate as perfect insects during the cold months of the year. In April and May they begin to be *en evidence* again and about the middle of May to end of June, the period of course varies, they couple and eggs are laid.

I am unacquainted with the life history of the insect in question and can find no mention of it in the Indian Museum Notes, but the above is the typical life-history of the family.

Pandit Gokal Das states that 'about two acres of the plantation were burnt and the ashes were sprinkled over the mango plants' and says that no more insects were found after this. This absence of the insects was more probably due to the fact that the mature ones after coupling had died off and only the egg stage was present, than to any wholesale destruction the burning of a small area would have if the attack were at all a bad one. Again he says "since writing the above, the insect has again commenced its ravages, having stripped some plants completely of all their leaves." These new insects would probably be the young brood hatched out from the eggs.

I have examined the young stems with roots sent to me: the plants were two years old, one year in the nursery and one year in the plantation, and were from 18 inches to 4 feet in height. There is certainly no mistake as to the damage done to the young stems, the bark having been in places often completely ringed off. The stems have been attacked in three ways. On some, the bark has, as above mentioned, been singed completely round, resembling some Coleopterous attacks. On others the bark has been eaten off in great angular patches whilst on a third stem I noticed the bark was hanging in long shreds all round the wood of the young stem. No leaves were on any of the young plants received by me, though several of them had the appearance of being not long dead.

The species of plant called sangtra sent was unknown to me, but appeared to be leguminous. Its root branches into several main stems at the surface of the ground. At this juncture, at a point which I should think would be just beneath the soil, I found a mass of eggs which are very like the eggs of some of the larger Acrididae known to me, though smaller in size. The eggs were attached together by some cohesive substance, were yellow in colour, rounded in section, about .1 to .15 inches in length and tapering very slightly at each end. They appeared to be rather dry and shrivelled up, and I should say there was no chance of these hatching out, especially as it would seem to be late for eggs.

The fact that neither the young Jaman (*Eugenia Jambolana*) plants which are either growing amongst the mango trees, or near by, nor the sangtra which is growing amongst the attacked plants have been touched is curious, as locusts are pretty well omnivorous where plant life is concerned.

Remedies—As to the remedies to be employed. This is always a difficult question to deal with as so much has to be taken into account. They are numerous enough but their application depends both on the means at one's disposal and also on the extent of the area to which they are to be applied. In this case, burning the sangtra amongst the mango plantation, has the effect of ridding the area burned over of the pests, but its effect on the whole area will depend very much on the proportion of area burned over to that over which the attack is spread. It is perhaps superfluous to remark that burning operations carried out in a young plantation of trees, are not exactly compatible with the production of strong and healthy plants.

In a case like the present, I should think there are four remedies which might be successfully tried, though they must necessarily depend on the extent of the plantation and the amount of labour procurable, of both of which I am in ignorance.

The remedies which I think might be tried are :—

(a) Hand-picking—Provided labour is procurable—a large number of insects should be got rid of in this way. In the cold weather invasion of 1890-91 of the locust *Acridium peregrinum* the villagers of Peshawar turned out and some eighty million young insects were destroyed at a cost of about 8,000 rupees, or 10,000 per rupee. This hand-picking should be commenced as soon as the insects are noticed on the trees so that they may be killed before their eggs are laid.

(b) Hoeing—If possible hoe up the ground after the eggs have been laid in it. The eggs thus get buried and if the young locusts do emerge they cannot force their way up through the superimposed layer of soil.

(c) Irrigation—I understand that a part of the area is watered by irrigation channels. If towards the close of the hot weather this part of the plantation can be kept under water for a period, all the young generation of the *P. didymus* present on this area, would be destroyed. After hatching, the young insects spend some days in a wingless state during which period they can only crawl.

(d) Weed Fires—If there is any wind, good weed fires giving forth a dense smoke should be made in favourable positions, so that their smoke may be carried across the plantation. This will make the locusts move off the area. A search should be made soon afterwards and any stupefied ones killed.

If any of the above methods are applicable to the plantation in question and can be inexpensively employed, I should think that the young trees might be saved this year from the ordeal which they had to go through last. I should be interested to hear the results attending the employment of any one of them.

CAMP RAIANG, TISTA VALLEY. }
9th January, 1896.

E. STEBBING.

Re-afforestation of the Mahasu-Fagu Ridge.

By

PUNDIT SUNDER LALL PATHAK.

Description.—The Patiala portion of the Ridge, called the Rajendra Rukh, is reached by the Hindustan-Thibet Road at Kufri, 7 miles from Simla due east. From Kufri to Fagu it is about 4 miles by the same road which passes along the northern slope of the ridge. Both places are on the Sutlej-Jumna water-parting, which runs nearly straight between them, forming the boundary between the Keonthal State on the north, and the Patiala State on the south slope; the latter State also owns a small portion of land on the north slope near Kufri. The water-parting of the ridge ranges approximately from 8,000 to 9,000 feet in altitude.

The northern slope is fairly regular, and moderately steep, whereas the southern slope is interrupted by several well-pronounced spurs, which give rise to a variety of aspects, especially a main spur, which branches off from this range southward from Chini-ka-theke (above Kufri), called the Manoon spur. The western slope of this spur is in the Simla Waterworks Catchment Area, and the eastern in the Rajendra Rukh or Patiala portion. This Patiala portion of the Mahasu-Fagu Ridge is drained into the Ohher-Nal which joins the Giri river. This Nal has an altitude of 6,000 to 7,000 feet above sea level.

The sub-soil of the ridge is generally an argillaceous shale, which though it is fairly hard, weathers somewhat rapidly, and is usually much disintegrated at the surface.

The surface soil is a stiff clay resulting from the decomposition of the sub-soil. It is deep on the north, and superficial on the south, where, on certain precipitous spurs, quartzite crops out. The soil on the Manoon spur is fairly deep, and has the same composition as that on the Mahasu ridge, but is to a certain extent richer, with more leaf mould. The average annual rainfall is from 70 to 80 inches; the greater part of the rain falls from the 15th June to the 15th September. Snow generally falls in January and February, and is sometimes found till the end of March on the northern slopes.

Above 6,000 feet, and up to the highest points on the range the principal species of tree are :—

Kailo or deodar (*Cedrus Deodara*), kail or blue pine (*Pinus excelsa*), rau or spruce fir (*Abies-Smithiana*), ban oak (*Quercus incana*), moru oak (*Quercus dilatata*), kharshu oak (*Quercus semecarpifolia*).

Of the above-mentioned species, deodar and kail grow freely on the southern slopes of the ridge and on the Manoon spur in Patiala Rajindra Rukh, and on the crests of the ridge on

the north slopes up to within a short distance of the highest points.

Besides the above described species, there are several less important trees and shrubs growing on the Mahasu-Fagu Range. Amongst the latter should be noted the beons (*Salix elegans*), a large shrub which grows well in almost all situations. Pindrau or silver fir (*Abies Webbiana*) and kopru (*Acer caesium*) grow in a few elevated depressions.

Wherever the soil is deforested, and is not cultivated or much grazed over, it becomes covered with a thick growth of under-wood, consisting mainly of *Berberis*, *Indigofera*, *Escholtzia*, &c., on the southern, and of *Berberis*, *Rubus*, *Prinsepia*, &c., &c. on the northern slopes.

This underwood favours the establishment of self-sown blue pine and spruce fir seedlings, and effectively prevents erosion.

Previous History.—The whole of the Mahasu-Fagu Range was more than 35 years ago thickly covered with a high coniferous forest mixed with the three Himalayan oaks, and occasionally with other evergreen trees, generally having a girth from 10 to 15 feet; survivors of these, and many burnt stumps can still be seen, both in the Patiala and Keonthal States.

When the population of Simla commenced to increase, and the demand for timber increased, the timber merchants (Kangra Sudhs) first of all commenced to work out the forests nearest to the station; and this range is one of the forests which were very heavily worked, and these merchants then paid here absurdly low rates, such as 4 to 8 annas per tree.

In the meanwhile, it was discovered that the colder situations were more suitable for potato cultivation, and within the next few years, almost the whole of the northern slopes, down to an altitude of 7,000 feet, the summit of the ridge, and other suitable and cultivable sites on the range were disafforested. Almost the whole area was laid out in potato fields; which were slightly levelled, and were unsupported by any stone work. These fields, after producing two or more crops, showed signs of exhaustion, the cultivators had recourse to manuring and were obliged to continue it. For this purpose they kept an enormous number of cattle, and large flocks of sheep and goats which were principally fed by lopping the surrounding valuable forest trees. By and by, when this sort of manure proved insufficient, and wood ashes were found to be a good substitute, nearly all the trees were cut down and burnt, to furnish ash manure. The cultivation of potatoes was continued with success up to 1879-80; the cultivators were mostly emigrants from Bashahr, Mandi and Kulu, and Sudh shopkeepers from Kangra. They only paid a nominal rent of 10 annas per bigha to the States.

Since 1881, the potato crops have been more or less failures, though for the last few years, crops have not been so bad on account of the introduction of some new seed. Thus the forest on

the range was gradually destroyed, and the ground was left quite bare. Owing to the heavy grazing, small landslips were continually occurring, and a large number of small torrents were excavating deep beds in the hill sides, and washing away the soil leaving here and there cropped-out shale and other rocks.

The Government of India called the attention of the Punjab Government in June 1885 and asked them to move in the matter of the reservation and re-afforestation of the Mahasu-Fagu ridge; to meet the apparent necessity not only for extending the present catchment area of the Simla water works in order to supplement the existing number of springs but also to secure the permanency of the existing springs, which it was feared would diminish in their water supply, and the growing scarcity and increased cost of wood fuel and timber. The Supreme Government laid especial stress on the importance of these matters. Both these wants the Government of India believed could be met by the constitution of a closed forest including the northern and southern slopes of the Mahasu-Fagu ridge, and it was further considered necessary that a block of forest of 8,000 to 10,000 acres should be obtained free of rights for this purpose.

In July 1885, the *Lieutenant Governor of the Punjab* deputed Colonel C. Beadon, then Deputy Commissioner of Simla, and Mr. H. C. Hill, Conservator of the Punjab Forests, to inspect and report and at the same time directed the former officer to put himself in communication with the Patiala and Keonthal States with a view to the lease of their respective portions of the range. Colonel Beadon, on the 14th December 1885, forwarded to the Patiala and Keonthal states the copies of the correspondence received from the Supreme and Local Governments indicating the feelings of Government in the matter, and asked for the lease of their forest lands on the ridge.

Colonel Beadon further asked the Patiala Darbar to make over to the British Government the whole of the Patiala parganah *Chhebrote* about 7 square miles in area, in exchange for the same area in British territory in the plains, or to lease it on a certain annual rent, which was not to be more than 2-3ds of the net revenue of the forest. The Patiala Darbar in response to the above correspondence, said that the State had always deemed it a great honour to be of some use to the Government, and it had ever been their desire to comply with the request of the Supreme Government. The Darbar, however, for obvious reasons, did not like to be deprived of the possession of the land in question but would prefer to carry out the scheme aimed at by the Government at their own cost, and thus save the Government from incurring a needless expenditure.

To satisfy the Government in carrying out their wishes, the State agreed to spend an amount of money, to sacrifice and to

sustain any other loss on the reservation and re-afforestation of the ridge, and accordingly issued orders to their Chief Forest Officer to submit his proposals on the subject for their sanction.

The Government, after due consideration on the Darbar's proposals, did not press further the subject of the exchange or lease of the forest, but in June 1887, consented to the offers made by the Darbar and deputed Mr. McIntyre, Assistant Conservator of Forests, Punjab, to inspect the ridge, and asked the State to depute their Chief Forest Officer to meet him on the spot to consider and submit their proposals to their respective Governments, which was accordingly done.

These proposals, which were all that could be desired, were in due course accepted by both Governments, thus saving the Patiala State from the loss of the territory, and the British Government from an unnecessary expenditure.

Proposal.—In the Patiala State, Mr. McIntyre proposed to reserve an area of 932 acres including the expropriation of 9 villages and Dochies (which area had about 200 acres of blanks and expropriated cultivation), out of which he proposed to sow with spruce fir and blue pine one hundred acres, in 10 years, leaving the remainder to nature. However, before receiving any communication on the subject from the British Government, the Patiala Darbar on the 4th December 1888, had sanctioned in full the proposals submitted by their Chief Forest Officer which involved an expenditure of Rs. 3,887 and an annual loss of cultivation revenue of Rs. 399.

The Patiala arrangements were identical with Mr. McIntyre's proposals, with the exception that they suggested the advisability of planting 200 acres, instead of 100 acres, the introduction of oak-sowing, and the formation of 6 fruit gardens on the expropriated lands between altitude 6,000-700 feet.

Results.—In the early spring of 1889, the State paid all the compensation, and declared the ridge reserved, and named it Rajindra Rukh, after the name of the present Chief. Then it was handed over to the State Forest Department for carrying out what they proposed.

After the evictions and demarcation had been settled, it was not possible during the first year to do more than start a few deodar and blue pine nurseries, and stock the 6 fruit gardens with the grafted apples, cherries, apricots, pears, &c., &c. which were kindly supplied by Mr. Coldstream, who was then Deputy Commissioner of Simla. Since 1890, however, regular plantation work has been carried on, an area of 30 to 40 acres being taken in hand every year. Thus there were two seasons every year for sowing and planting.

(1.) The rainy season, during which the sowing of kharshu oak (*Quercus semecarpifolia*) on the highest parts of the summit of the ridge in lines 5×5 feet was carried on; also the

transplanting from nurseries of kail, blue pine, on altitudes between 7,500 and 8,500 feet, and the planting of seedlings brought from adjoining forests, in triangular patches. This was followed by deodar transplanting in lines 5 × 5 feet both of plants from nurseries and also of seedlings brought from adjoining forests, on altitudes between 6,000 and 7,000 feet. In addition, willow and poplar slips or cuttings were put down at those places where denudation was in progress; and rhizomes of Ringal (*Arundinaria falcata*) were planted in moist and shady ravines. These works were carried on yearly.

(2). In the autumn season *before* the snowfall, other works were done. Thus, in the autumn of 1890, as an experiment, at altitudes above 6000 feet, some walnuts (*Juglans regia*) were directly sown in well manured pits 1ft. × 1ft. × 1ft., in lines 5ft. × 8ft., and 8ft. × 12ft. apart. The seed was sown just before the snowfall, and was found germinating in the beginning of the following March, just after the snow cleared away. These young walnut plants made good progress during the following rainy season. Walnut culture was carried on very successfully in each succeeding year, and its adoption, in addition to the plants originally proposed, was made for 3 reasons:—(a) the soil appeared eminently suitable for its culture; (b) its growth is more rapid than blue pine or spruce fir, and (c) its timber is of more value than theirs; and, in time, a certain income may be expected from its fruit. Besides this, the horse chestnut (*Aesculus indica*) was sown in pits 5 feet apart, in lines, and the lines at 6 feet apart; also blue pine in horizontal lines 5ft. × 5ft. at and above 8,000 feet above sea level. Direct sowings of deodar were also made in pits 10 feet apart in lines and interplanted with peaches for shade during their early growth, between the altitudes of 6,000 of 7,000 feet. Firs were also sown in the same manner as the above conifers, but were afterwards abandoned on account of the greater success of the walnut. The moru oak (*Q. dilatata*) was also sown in the same manner as kharshu, but on lower altitudes; the results, however, were not so satisfactory. As underwood, peach, apricot and other trees were planted for the sake of giving shade to the deodars, when young, and also in places where the soil was very poor, or much washed away, or too exposed.

Fruit Gardens. In the same way, in the fruit gardens plants were continuously raised from the best seeds, and offsets; then were grafted and planted in permanent places. The fruit trees chiefly grown were the cherry, apple, pear, quince, almond, plum, peach, apricot and Spanish chestnut. These fruit gardens have grown up well with all the species of grafted fruit trees put in them in 1889, and those locally raised and grafted, which have commenced to bear fruit since 1894.

All the sowings and plantings detailed above were carried on every season, on the whole with remarkable success. There have been but few failures, and the cost has been far below the amount originally proposed and sanctioned.

The plantations were inspected in 1894 by Mr. G. S. Hart, Deputy Conservator of Forests, Simla, who expressed himself as pleased with the results of the work done. His report was endorsed by the Commissioner of Delhi and finally forwarded to the Maharaja with the expression of the Lieut-Governor's satisfaction. At the time of inspection, 180 acres were found practically stocked, and the most noticeable success was that of the walnut, the sowings of which looked very well.

Die Mathematik und der Wald.

A propos of a short poem with the above title in the October number of the 'Révue des Eaux et Forêts,' 'C.B.' makes some pertinent remarks with which I think many Indian foresters will heartily sympathize and which may serve to reassure some of those who have perchance become somewhat frightened of late at the mathematical intricacies of recently published works.

The article referred to contains several references of recent protests made by Italian foresters against the increasing abuse of mathematics in Forest matters. One of these writers while admitting the possible usefulness of abstruse mathematical calculations in the case of the large and valuable forest areas of Austria and Germany, maintains that these are at any rate quite out of place in Italy, where the problem to be solved is how best, in the interest of the agricultural population, to *improve the condition and increase the extent of those, generally small or impoverished forest areas, which have escaped destruction.* "Here" the writer states, "it is simply a question of Sylviculture and Finance and not by any means one of Algebra."

If this principle is admissible in Italy, it would seem to be at least equally applicable to India where the conditions are even less uniform and consequently still less favourable to the application of mathematical formulæ. The first duty of a Forest Officer in India is surely the improvement of the forests in his charge, while at the same time, he endeavours to utilize such material as may be marketable within such limits as are compatible with improvement.

Elaborate formulæ, however interesting their study may be for the theorist, will hardly assist one in attaining this end; and it is, I think, fortunate that European Foresters are beginning to recognize the danger of thus missing the substance while straining after the shadow, and that we in India have such a

practical little book as the late Mr. D'Arcy's Manual on the preparation of Working Plans for our guidance.

Though some of the writers referred to in the article by 'C.B.' are not perhaps altogether complimentary to the German teaching and to some of the celebrated German forest economists, one cannot help sympathizing with their protests. It is a noticeable fact that practical German officers too are beginning to deprecate this tendency to reduce all forest questions to a mathematical equation, indeed the author of the poem with which C. B's article commences is a German Forest Officer stated to be as well acquainted with mathematical formulæ as with economic laws and an officer of some repute in Alsace, one of best schools of practical forest economy.

AN INDIAN FORESTER.

II.-CORRESPONDENCE.

Summary of Progress during the five years 1889-1894.

In accordance with the usual custom, the principal measures and events which have marked the progress of Forest administration during the last quinquennium are recapitulated as an introduction to the Annual Review for the year 1893-94.

2. The Department of Revenue and Agriculture of the Government of India continued to administer the Forest Branch of the general administration, and during the period under review the Honourable Members of Council in office have been Sir P. P. Hutchins, K. C. S. I., from April 1889 to November, 1893, and Sir A. P. MacDonnell, K. C. S. I., from November, 1893 to the close of the quinquennial period. Sir E. C. Buck, Kt., C. S. I., as Secretary to the Government of India in the Department of Revenue and Agriculture, conducted the Forest business throughout the period, with the exception of from the 20th March to the 4th October, 1890 and from the 7th August to the 30th December, 1892, when Mr. W. C. Bennett and Mr. Muir Mackenzie officiated for him, respectively.

Mr. B. Ribbentrop, C. I. E., who continued to perform the duties of Inspector-General of Forests, was absent on furlough for nearly 19 months (August 1889 to March 1891), during which time Mr. H. C. Hill, Conservator of Forests, acted as Inspector-General.

3. There has been an increase in the area of permanently settled forest estates from 54,323 to 71,589 square miles, and much has been done in completing, on a strictly legal basis, the record-of-rights of both the State and the people to forest estates or their produce. As stated elsewhere, it has been the policy of Government, during the period under review, "to determine what area of forest or waste land in each district is necessary to meet in perpetuity the requirements of the people in timber, fodder or other produce, and to provide for its settlement and demarcation as a reserved forest."

4. The Indian Forest Act (VII of 1878) and the Burma Forest Act (XIX of 1881) were amended by Act V of 1890, in order to provide for the exercise by the State of a greater control over all forest produce wheresoever obtained, and to regulate the practices of shifting cultivation and the compounding of offences. In 1891 a special forest regulation was passed for Assam to replace the Indian Forest Act, which was found unsuitable. Special regulations were also enacted in 1892 and 1893 for Ajmere and Merwara and for Hazara in the Punjab.

Of rules made by Local Governments, those made in the Central Provinces in 1891, under Act XVIII, for the conservation of malguzari forests, are deserving of notice.

Measures to afforest and check the disastrous effects on the underlying plains of the bare sand-hills of the Hoshiapur district were again brought under consideration, and it is hoped that a definite line of action will be decided upon, with a view to its adoption whenever money can be spared for the purpose.

5. Under forest organization much progress has been made during the quinquennium. Surveys have been carried out in the various provinces at a rate which has resulted in the mapping, on an average, of some 3,000 square miles a year. Working-plans have now been prepared for considerable areas, with the result that 7,754 square miles of forest were in 1894 being systematically worked under sanctioned working-plans. A work entitled "Notes on Forest Working-plans," compiled by the late Mr. W. E. D'Arcy, while holding the post of Assistant Inspector-General of Forests and Superintendent of Working-plans, and published in 1892, has proved useful in simplifying the more recent plans and giving to them that uniformity of preparation and record, without which the control of their application would have been most difficult, if not impossible. A new edition of the work is about to issue.

6. The general protection of the forests from theft and encroachment is an easy matter. Their protection from the destructive effect of fire, and from illicit or unregulated grazing, presents the greatest difficulties. Still much has been achieved. Under fire-protection, results cannot be gauged from year to year, owing to the variation in the seasons; nor can they be compared from province to province, owing to the different prevailing conditions.

The extension of the protective measures which has taken place during the past five years, with the average failures and cost-rates for the periods of five years preceding and following the year 1889, are exhibited in the following table. They serve to indicate the progress in the different provinces:—

Fire-Protection.

PROVINCE.	Area attempted, in square miles.		Average percen- tage of failures for five years.		Average cost per square mile for five years.	
	1889-90.	1893-94.	1884-85 to 1888-89.	1889-90 to 1893-94.	1884-85 to 1888-89.	1889-90 to 1893-94.
					Rs.	Rs.
Bengal ...	1,217	1,171	19	14	14	9
North-Western Provinces and Oudh. ...	2,199	2,642	5	4	25	19
Punjab ...	427	318	6	9	5	7
Central Provinces ...	2,887	8,338	5	5	14	12
Burma (Lower) ...	378	586	15	7	58	59
" (Upper) ...	12	62	...	33	...	42
Assam ...	1,057	1,153	3	12	34	16
Coorg ...	202	205	17	11	24	31
Ajmere ...	139	89	...	...	4	2
TOTAL ...	8,519	13,242	9	9	19	16
Barar ...	1,059	1,382	3	2	6	7
Total Bengal Presidency	9,578	14,631	8	8	17	15
Madras ...	4,600	5,044	6	5	13	10
Bombay ...	10,638	9,809	10	15	...	2
GRAND TOTAL ...	24,825	29,484	8	10	8	9

The regulation of grazing has been systematised under working-plans, and wherever these have been prepared the necessary restrictions so imposed, after full consideration of requirements and the forest's capabilities, and enforced continuously over a number of years, come to be readily accepted by the people. In such cases it rests with the forest establishments to see that duly authorised closures of areas are properly carried out, and that trespass is prevented.

Large areas have still to be dealt with ; but with the advance of organised management, these will be gradually brought under such protection from cattle as the local circumstances may render necessary or possible.

7. The improvement of the forests by a course of improvement-fellings, made with a view to increasing the proportion of healthy promising stems in the crop, has been proceeded with wherever a demand for produce exists, or, in the absence of a remunerative demand, to the extent for which funds and superintendence were available. Aid has continued to be given to reproduction by means of the planting of teak in clearings made for shifting cultivation in Burma and the broadcast sowings in Bombay ; and the growing stock in the Himalayan forests has been improved and rendered more complete by planting and sowing.

The opening up of the forests by lines of communication and export, the expenditure on which is usually immediately profitable, has received special consideration in various provinces ; but there would seem to be scope and encouragement for the further investment of money in this direction.

8. The quantity of forest produce annually yielded by the forests and utilised has largely increased. It amounts in round numbers to more than 150 million cubic feet of timber and fuel, 130 million bamboos, and nearly 4 million rupees' worth of minor produce. These enormous supplies of produce represent as yet, however, only a fraction of what the State forests will yield hereafter. With a view to the development of a more extended utilisation of the forests, cheap handbooks edited by the Reporter on Economic Products containing useful information on raw products, are now issued.

9. Financially, the progress of the past five years has been well sustained. The gross receipts have advanced from 139 to 177 lakhs of rupees, while the surplus has increased from 57½ to 88½ lakhs. Some grounds for doubt would seem to exist as to whether so large a proportion of the gross receipts should be appropriated by the present generation, or whether more should not go towards the improvement of the capital value for the benefit of the future.

10. The reorganization of the controlling staff sanctioned in 1891 was a measure of much importance, but unfortunately its full beneficial effect is held in check for want of a more efficient subordinate forest staff, the reorganization of which was in fact a part of the same scheme.

The desirability and economy of entertaining both executive and clerical establishments of a strength to meet requirements, including the best utilisation of the controlling staff, are recognized by the Local Governments, by whom repeated representations have been put forward on the subject.

Wood-working Machinery.

"Modern Wood-working Machinery" by. J. Stafford Ransome, and published by William Rider and Son, 14 Bartholomew Close, London, E. C., although of special interest to persons owning large Saw-mills, is also very useful reading to foresters. We suppose that "Rider's Technical Series," of which this little book forms part, allots fixed limits to the space to be given to each particular head—otherwise we should have felt the sense of disappointment that an author who is evidently so thoroughly well versed in the details should not let himself out more and give

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us a further account of the different matters of which he writes. We think such a book would be valuable. There is a good deal in Mr. Ransome's book with which we have not much concern, as the Chapters on Tenoning and Mortising machinery and others, but all connected with Saw-mills, tree-felling, and the handling of timber will repay our perusal. The tree-felling machines are especially curious. It is true that hitherto Saw-mills have not been found successful in Indian Forests, yet there are firms in Calcutta and Bombay, and in the large coast towns of Burma, where Saw-mills are working, and it may be that the rise in price of labour, the increased output of the Forests, and the improvement in communications, may some day again lead the Department to set up mills. One would not think that the Vosges was an exceptionally likely place for Saw-mills to pay in, yet what numbers of them there are. As a suggestion—how would a Mill pay in the Andamans? but perhaps it is better to leave such things to private enterprise.

Forest Administration Reports for 1893-94 for Bombay, Baluchistan and Burma.

The forest area in the four circles of the Bombay Presidency now amounts to 14,100 square miles Reserved and Protected. They are divided as follows :—

Northern Circle	1,589	} but the Northern Circle has also 678 square miles of leased forest in the Dangs.
Central „	6,157	
Southern „	5,372	
Sind „	982	

In the Central Circle Report there is a discussion of the question of the sufficiency of the forest area and it is shewn that forests cover 16 per cent of the country and that there are 0·63 acres per head of the population, which are almost exactly (see Schlich's 'Manual of Forestry, I. p 54) the same proportions as exist in France. Mr. Shuttleworth says :—

“These figures may provoke reflection as to whether the State forests which have been formed are sufficiently extensive, and in their spread are suitably located in all directions to promote all the interests, and to maintain all the harmonies dependent upon an efficient system of forest conservancy management in a country circumstanced and conditioned as the Central Division of this Presidency, where the rainfall is at all times uncertain and capricious, and is confined to a short season, the remaining portion of the year being dry, and where there is a great demand for timber and firewood. There are practically no private forests left undestroyed in the Násik, Ahmednagar, Poona, Sátára and

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Sholapur Districts above the ghats, and there is a very noticeable absence of trees generally upon lands occupied for cultivation in the wide-stretching champaign country of the eastern portion of the Deccan, including the whole of the Sholapur Collectorate. On the other hand, the necessity for a very much larger supply of cheap fuel, and for a more general distribution of it, than is at present within the capabilities of the State forests in the champaign country in their position and their power as now existing, in order to lessen the consumption of cowdung as fuel, and to permit of its more extended use for manuring fields of cultivation is a question of the highest importance in the interests of agriculture. Moreover the influence on the climate of an extensive growth of trees for lowering the temperature and overcoming aridity, and for affording protection against winds and sun on the plains, is of equally great importance in the interests of the food supply for man and beast. The larger proportion of the forests in the champaign country of the Eastern Deccan contains very poor and hard soil: these lands had been entirely divested of all ligneous vegetation before they were placed under forest conservancy management, and it will take many years for firewood to be produced on them in such volume as to give an appreciable annual yield for the feeding of local supply. But the difficulty of obtaining more land possessing such good soil as is necessary for a quick growth of trees, and an early production of timber in these parts is seemingly insuperable; for it lies in the dearth of any suitable waste land, the property of Government; in the growth of population with a concurrently increasing demand for lands of good soil for purposes of cultivation; and in the heavy cost of acquisition of occupied lands, if acquisition were otherwise practicable. The forests on poor soil which may be taken at three-fifths of the forest areas of the Eastern Talukás cover uplands, watersheds and hill slopes; and have in addition to supplying pasturage to the cattle of the country, important mechanical functions to perform; and they even now, when their reboisement is a long way off completion, arrest in a large measure the off-flow of the rain water which falls upon them, storing it for a more gradual distribution in natural course: and they work, though still very imperfectly, as high level reservoirs for the natural irrigation of the country."

From Sind it is reported that while 6,681 acres were lost by river erosion, 11,803 acres were gained, and on this and the much vexed question of bunds, Mr. Ryan says:—

"The areas gained will not be useful for probably eight or ten years, while the area eroded consists in many instances of good old established forests and this unfair exchange is likely to continue for a number of years, owing to the results of the bund system; and this is said, without in the least degree wishing to

provide for meeting the demands of local supply as far as it is possible to do so, with due regard to a sustained yield, and to the maintenance and improvement of the factors of the localities. A system of numerous small forest blocks in a country such as the Central Circle is seemingly the best calculated to satisfy, in the greatest degree attainable, all that can be reasonably expected and required of the forest management. A large number of forest blocks with one compartment in each, which is treated for the exploitation of timber and other produce, and for natural combined with artificial reproduction, furnishes many centres for the employment of unskilled village labour, and the utilisation of village transport for the conveyance of timber and other forest produce to their destinations when removed from the coupes. In every Deccan village there are carts and bullocks and when the latter are not employed in agriculture their owners are very glad to secure their employment in traffic; and many coupes also provide as many centres for a much more general distribution of timber and other forest produce over the face of a district than could be secured by a few fellings of larger individual spread, but located at considerable distances apart. The working plans are based entirely on area, for it is not possible to foresee the future of the forests, such as they are, from their present condition and their past history. Briefly then the forests of every range which corresponds with a revenue sub-division, are being differentiated into as many small forest blocks as local circumstances and existing conditions may require; each of these forest blocks is considered to be a separate unit of working, and it is sub-divided into 40 working compartments, to be exploited in turn, if there is anything to fell and remove, and to be treated for regeneration alone during the first revolution, if there is nothing to fell and carry out. Cultural rules are prescribed for regulating the extent of the felling, and the selection of trees to be reserved within the compartment which is to become the coupe of the year, because in making fellings the nature of the soil, the climate, species, and even individual trees require to be considered in guiding the axe. The following are the rules in observance for the deciduous forests in which the teak tree predominates:—

(A). Quality of standard:

1st.—Trees to be marked in reserve should, if possible, not be less than 18 inches girth at breast-height; but may be of any greater size, provided they are healthy and likely to live through the rotation.

2nd.—Seedling trees are to be preferred as standards; otherwise coppice shoots from a small stool, straight, clean-stemmed, and with a strong leader should be chosen. If really promising young trees cannot be found, then the healthiest trees, those most likely to produce good seed, must be marked.

'3rd.—As much as possible trees of various kinds should be reserved, but the most valuable kinds should be preferred.

'4th.—If the existing crop is nearly pure teak, special care must be taken to reserve other kinds, even if good trees cannot be found: similarly, if teak is very scarce, even inferior teak trees should be reserved.

'5th.—The quality of the trees to be reserved must be carefully considered; but on steep slopes, tops of hills, ridges, &c., whatever is available must be reserved.

'6th.—Fruit trees, such as mango, mhowra, toddy-trees, temburni and apta trees, if sound and flourishing, should, as a rule, be reserved.

'7th.—Very inferior kinds of trees which have no value as timber and very little as firewood should be kept as standards only when other kinds of trees are obtainable.

'(B). Number and Distribution of Standards:

'8th.—All promising young trees of any valuable kinds under 12" girth at breast-height shall be preserved, and shall not be felled.

'9th.—On flat, undulating, or gently sloping ground an average of 15 trees to the acre to be reserved.

'10th.—On steep slopes up which a man can walk without much difficulty, an average of 20 trees to the acre.

'11th.—On very steep slopes where a man must climb rather than walk, an average of 30 trees to the acre.

'12th.—Crests of hills, ridges, precipitous upper slopes require protection, and all trees suitable for reservation should be kept.

'13th.—Heads or commencements of water-courses require protection, and standards of all kinds should be reserved in clusters or groups in such places.

'14th.—Along banks of rivers or large nálas, trees should be freely reserved up to a distance of about 20 yards from the edge of the bank.

'15th.—Blanks within a coupe require special attention; all trees, however poor, within them must be preserved, as well as a fringe all round.

'The suitability of the system to the trees to be found in the forests is one of the main points to be attended to, and in fixing the revolution at 40 years, as has been adopted generally for all the forests, due provision has been made for allowing a fair period of life-time to trees of all kinds in the forests. In Forestry, trees, as a rule, are felled before they have reached the natural end of their life. In the case of river side bábool reserves in the Deccan, experience has shown that a tree attains a girth of 4 feet in about 40 years, and after this the tree begins to become unsound internally: therefore the bábool tree is subjected to a system of clear cutting, and the ground cleared is treated for artificial regeneration; or in other words, at the end

of the rotation the wood is cleared off the area and the process of creation is recommended. In the mixed and deciduous forests where the teak trees predominate, such trees as promise to outlive the rotation, or another period of 40 years, are reserved and are not felled; and thus a life-time of 80, 120, 160, or 200 years even may be given to an individual teak or other long-lived species under a treatment of the selection of the fittest at the time when the revolution brings a compartment to become the coupe of the year. In the region of heavy rainfall where the forests are evergreen, only trees that are being suppressed, and those that have no future are removed, here the weight of rain-water that falls on the ground is excessive, and its eroding potentiality in descending steep hill slopes is a danger to be guarded against. A rotation of 40 years for a forest block gives a convenient arrangement for working the opening and closure of forests for grazing."

In these Reports there is a great deal of information regarding the growth of trees and of their marketable uses and value. The Central Circle Report gives an account of the value of the 'babul' tree in the Deccan which shews that it is quite the most important tree in that part of India, whether as giving timber, fuel, gum, tanning material, fencing or fodder, and he explains that coupes of babul occasionally fetch as much as Rs. 60 per acre. Among other trees of value he mentions the 'Nim' which, as we have ourselves seen everywhere in the Madras Deccan country, as well as in the Carnatic, is one of the most valuable trees for restocking barren areas. From the Southern Circle it is reported that teak comes up excellently from seed in Kanara and can force its way even through thick bamboo cover, a piece of observation which will probably astonish some of our Burmese readers. The Sind Report discourses on the growth of babul, poplar and kandi or jhand and we think it best to extract a few of Mr. Ryan's remarks, which, though not very new, may be interesting. We were unaware that the Sind poplar could not be reproduced from cuttings like the poplars of Europe:—

"Babul (*Acacia arabica*) is found growing gregariously in only a part of one forest in Upper Sind. In Central and Lower Sind there are unmixed canopied babul forests on the river side with trees of 6 and 8 feet girth, all formed by natural means before the bunds as at present constituted existed. All that is done now when exploiting these areas is to fence them immediately after being cleared, and after the inundation a dense crop of seedlings covers the ground without any artificial aid. These seeds are distributed by wind, flood and animals. By protecting the area from the depredations, especially of goats and camels, in 8 or 10 seasons the crop is ready for exploitation again, and probably 500 cubic feet of saleable wood per acre is available from it. Measurements taken of babul in the Province

show that, in little less than five years, this tree under favourable conditions of soil and moisture attains a girth of $1\frac{1}{2}$ feet at 4 feet from the ground. In no other part of India probably are such favourable conditions apparent, and it is mainly because of these satisfactory conditions that the Sind forests are probably the most valuable in India. It might seem, therefore, that silviculture is rendered very easy under such circumstances but the fact is, that the country is infested with large flocks of goats and hundreds of camels, and the greatest difficulty possible is experienced in protecting the fenced-in areas although large hedges 6 to 8 feet high are constructed to exclude the animals. The babul in consequence of the tremendous spur owing to favourable conditions of soil and moisture, would, no doubt, still grow if left unprotected, but it would remain in the form of a scrub, and very few plants would probably go beyond that stage. Fortunately in the fresh alluvial lands, goats and camels do not, as a rule, penetrate to a very large extent; camels are afraid to go because of their liability to sink in the "gup" or soft mud of which the kacha land consists. They restrict themselves chiefly to the forests of older formation, and in consequence of this, on the new kacha lands, young babul may be seen forcing itself up ultimately to form canopied forests if not eroded by the river.

Bahan or poplar, (*Populus euphratica*) which commands a very good price in the market, in spite of its crooked bole, is entirely grown under natural conditions. In several localities in Upper and Central Sind it grows abundantly on the fresh alluvial formations, and in less than a dozen years suitable poles for dwellings are available, the value of which is Rs. 30 to Rs. 40 per 100. Attempts to reproduce the tree artificially from seed have been tried in the more permanent lands but without success, and such attempts, it is thought, will never be fruitful because the seed is extremely light and delicate, and like thistle-down and willow-wool is carried away in the breeze, and is only capable of germination in localities where the soil is of extremely soft consistency. Attempts to reproduce the tree from cuttings have also been tried, but without success. All that can be done is to fence in the areas self-clothed with young poplar, when the soil has sufficiently stiffened, and to protect seedlings from the depredations of buffaloes, bullocks and cows, who are very fond of the new and succulent young poplar leaves. To the damage caused to the poplar in its early stages by these animals, may possibly be ascribed its present crooked growth; but the tree being a very shallow rooted one and growing in localities exposed to the full force of the breeze, it is more than probable that the swaying about, to which it is subjected induces a sinuous growth. Perfectly straight poplar poles and rafters are rarely, if ever, found. The tree coppices readily, and from the roots, which spread out

laterally and run just below the surface, a heavy crop of young poplar springs up. After a fire in the Azizpur Forest, in the Sukkur Division, in an area where there were several mature poplar trees, young poplar was found freely springing from the roots at 30 feet from the parent tree. It flourishes along the Indus as far down near its mouth as Kot Almo, a reserved forest, a few miles north of Tatta in the Shahbunder District. The railway have tried it as fuel and rejected it; and the only use it is put to is for timber.

Kandi (*Prosopis spicigera*) is found growing away from localities subjected to heavy inundation. It possesses great vitality, grows rapidly, and coppices with astounding rapidity where the stools are not entirely submerged by flood. In any felling operations, therefore, which are undertaken care has to be exercised not to cut the stools low down otherwise after-results are nil. On being fully established the tree can exist without surface irrigation and will coppice freely although it is doubtful whether under such circumstances it will survive a second felling. The roots of this plant enter very deep in the sub-soil, and there is one instance recorded by Sir D. Brandis, where the root penetrated upwards of 70 feet. In view of this characteristic it would possibly be a better tree to plant along the base of bunds than babul which is a very shallow rooted plant and easily uprooted by wind and flood."

On the subject of produce there is nothing to add to the notes which we made last year, except to notice that Mr. Ryan adds himself the number of persons who have so often advocated the development of the trade in the fibre of the 'ak' plant, *Calotropis gigantea*.

Last year, we drew attention to two very interesting points about the work in the Bombay Presidency, and we find both of them very prominently mentioned in the reports, now before us. One is the very extensive use made of the Forest Guards in various works, sowing seeds, planting, cutting tamarisk on forest rides in Sind, eradicating cactus, and what not; and the other is the large area covered by works of artificial reproduction in the Central Circle, where it seems that 19,876 acres were treated under regular planting or cultural operations at a cost of Rs. 9,145 or only a little more than As. 8 per acre. Mr. Shuttleworth remarks:—

"The cultural operations undertaken by the forest guards as a part of their ordinary duties, cannot fail to promote the re-wooding of the country. All the forest region of the Circle is parcelled out into beats, not an acre of land in forests is left outside of a beat, and each beat is an unit of seed collecting and of sowings, i.e., of artificial cultural operations by forest guards. So that re-creation, the chief work of forest management in the Deccan, goes on yearly, to a limited extent it may be, in 1,094

'beats in the Central Circle, without any extra cost to Government."

We have always read the accounts the work done by Forest Guards in Bombay with envy, but were puzzled to understand how they did their other work. However, we now perceive that each Forest Guard has only an average beat of about 5½ square miles which is, of course, a much smaller area than is usual in most other Provinces.

The favourable reviews by the Commissioners and especially that by the Commissioner in Sind, which shews great personal interest in the forests and knowledge of forest work, are very noticeable this year and the sympathetic tone of their remarks and of the Government review is a great improvement on the strong adverse criticism of a few years ago. In the Government review, the chief noticeable point is the recommendation of fencing. They say:—

"It is observed with regret that except in Sind, comparatively little was done in the year under review in the matter of fencing. The Governor in Council regards it as of great importance that such closed areas as adjoin grazing grounds should be fenced as soon as funds are available. If there is nothing to prevent trespass except the occasional visit of a guard who may have several villages to look after, trespass is sure to be general. The proportion of offenders who are detected must be minute, and if the chance of detection is small, the punishment in any form of the few who are detected can have little or no deterrent effect. Where there is a visible obstruction to trespass either of cattle or of people for the purpose of taking forest produce, it is not likely to be removed, and in such case offenders can have no sympathy from law-abiding people on the ground of ignorance of what is prohibited."

We are strong advocates of fencing of some kind wherever it is practicable, but in many places where the forests are extensive and the length of boundary great and perhaps interrupted by ravines which cannot be fenced across, or paths which must be left open, fencing is often nearly prohibitive if only from its cost, and in such cases surely a well-kept boundary line with good marks should be ample as a warning against trespassers, or else why were Reserved Forests specially placed in the Forest Act on the same footing as public plantations are under the Cattle Trespass Act.

The financial results of the forest year were—

Receipts,	...	Rs. 37,85,691
Expenditure	...	„ 20,97,027
Surplus	...	„ 16,88,664

We can now conclude with one more short extract to show that even in a serious Government Report an Officer may occasionally be allowed his little joke.

"Large timber is a necessity in India, and the forests in the wilder parts of the country can be devoted to its production; and there the more vigilant forest guards, at all times active and keen and ruthless in protecting the natural reproduction against destruction from trespassing cattle, are *Felis tigris*, *Felis pardus*, *Felis jubata*, and *Cuon rutilans*."

The *Baluchistan* Report is chiefly interesting on account of the discussion on the questions of the area of forests to be adopted for reservation and the financial prospects of the Shebo Plantation. From Mr. Reuther's Report it would appear that this plantation was started in 1889 and that there are now 2,682 acres completed. The cost of the plantation up to date has been Rs. 100,737, (which after all, is only, Rs. 37-8 per acre, not so very large a sum for plantations in a difficult country) and the future expected yearly expenditure is Rs. 13,000 for the next 5 to 10 years. So far, the revenue, chiefly from crops grown on the land to break it up, has been Rs. 10,346 and the Divisional Officer, the Agent, and the Government of India seems to have become rather frightened, the Government of India going so far as to "regret that owing to 'slackness of supervision public money has been 'unprofitably 'spent.'" Of course, being ignorant of the locality and of the state of the plantation, we are not quite competent to judge, but we venture to think that matters may not be so bad as they would seem. One cannot make plantations without expenditure and we doubt whether some of those which we are accustomed to point to as great successes (*e.g.* Nilambur) have cost very much less, especially if debited with the pay of the supervising officers. Then, too, one cannot expect a plantation to begin to pay straight off, especially in a dry climate, and it may be that the Shebo plantation when once it begins to come into working, will very soon pay off the capital expended on it. Mr. Reuther says "ultimate success 'may be confidently expected, though at a very high cost, and regarded as a merely financial investment, ultimate profit cannot 'as yet be predicted.'" Assuming that in 10 years time there will be 3,000 acres fully started and beginning to give some yield and no longer requiring irrigation, the cost will have been Rs. 1,00,737 + Rs. 13,000 \times 10 = Rs. 230,737 or about Rs. 77 per acre. The expenditure can probably then be reduced very greatly and working begin. Assuming Rs. 6,000 as the yearly expenditure, the gross revenue will have to be 13,000 Rs. in order to give 3 per cent interest on the Capital (Rs. 7,000). This amount will probably not be obtained at once, but ought not to be difficult to get after a few years. A well started and flourishing plantation of 8,000 acres of good trees ought to be a very paying property in the end in such a country as Baluchistan.

Turning to the question of the area to be permanently reserved, Mr. Reuther's account of what has been done and what might be done, were certain difficulties removed, is so interesting that we propose to quote it,

"The Ziarat juniper tract, is the only extensive forest region in Baluchistan. But outlying and scattered patches of juniper, pistachio, olive, sissoo, etc., as well as several tracts of scrub-jungle in the Sibi plain, have already been reserved to an aggregate extent of 115 square miles. So far as professional forest exploration of the country has as yet extended, no further outlying tracts have been found fit to be specifically recommended for constitution as State Forest, excepting those mentioned below, aggregating 77 square miles. Whether more extended and minute examination of the country generally will justify proposals for reservation of other areas is problematical, but the probability is that such areas will not prove to be of any important extent, excepting possibly in the Zhob District which is beyond the scope of the present considerations, partly because the Zhob District has as yet been only cursorily explored professionally, and because all forest management in Zhob has for the present been assigned exclusively to the District authorities.

The present situation is more clearly illustrated by the following tabular summary.

AREA, IN SQUARE MILES, AVAILABLE FOR STATE FOREST.					REMARKS
CHARACTER.	Already reserved.	Specifically proposed for reservation.	Physically suitable for reservation.	Prospective maximum of available area.	
'Ziarat juniper zone ...	18	25	35	78	137 square miles in the Ziarat juniper zone are not fit for reservation.
'Outlying tracts in which juniper predominates ...	51	17	Indeterminate; but in-extensive.	68	
'Mixed forest in the hill-ranges ash, olive, pistachio, tamarisk, etc. ...	24	35	Ditto ...	59	This area of 59 square miles contains a little juniper here and there.
'Mixed scrub-jungle in the plains (Sibi)...	35	...	...	35	
'Irrigable land suitable for artificial plantation ...	5	0.6	Ditto ...	5.6	
TOTAL. ...	133	77.6	35	246	

'It is evident from the foregoing statement that the main hope of any valuable extension of the area of State Forest in Baluchistan (excluding Zhob) still centres in the prospect of further reservation in the Ziarat juniper tract. As long ago as 1889 a committee composed of the Political Agent Thal-Chotiali, the Forest Officer, and two native members of the Political Staff, considered the question and submitted a report to Government showing that out of the whole area physically suitable for reservation, at that time computed at 67 square miles, only 18 square miles (including 6 square miles previously reserved) could be immediately secured for constitution as State forest, and this area of 18 square miles has actually been reserved as the direct result of the recommendations of the committee. But reservation of a more extensive area was found by the committee to be impracticable and impolitic, as involving undue restriction of pasture-rights hitherto exercised without restraint by some 1,245 families, owning upwards of 60,000 sheep and about 2,000 cows and other cattle, who for five to seven months each year habitually live within, or near, the juniper forests.

"The committee, however, declared that whenever it should be found possible to throw any of the State Forests open to grazing, additional areas might be reserved. As, however, in the very poor condition of the forest and the peculiarly adverse climatic conditions of the country, improvement and regeneration cannot be ensured without complete exclusion of sheep, goats, and camels for a period the duration of which must be regarded as practically unlimited, this declaration by the committee affords no tangible prospect of any possible extension of the area to be reserved as State Forest and as a matter of fact no additional area (beyond the 18 square miles selected by the committee in 1889) has yet been secured in the Ziarat juniper tract.

'The considerations which at that time curtailed the area of the proposed Ziarat State Forest have remained in force ever since, and constitute essentially a question of State policy, in the settlement of which the Forest Department can have no leading voice. Whether, however, sufficient pasturage can be found for the 60,000 sheep and goats in the 137 square miles of sparsely-wooded juniper tract permanently excluded from the proposals of the Forest Department, and in the large areas available outside the juniper region, a question which, in view of the paramount influence on Forest conservancy in Baluchistan, might well be made the subject of further investigation.

'But in the event of finality of the decision that the extensive flocks afore-mentioned cannot be wholly excluded even from the limited area proposed for reservation, it will be worthy of consideration whether the proposed reservation should out be carried out nevertheless (to the full extent of the remaining area of 60 square miles of promising juniper forest), and the exercise of

'certain defined and limited pasture rights admitted under proper regulation.

'In addition to the objections based on the pastoral interests of the nomad shepherd population, financial considerations have also contributed to hinder more rapid expansion of the area of permanent forest estates. The present impossibility of working the forests profitably has been repeatedly urged as a reason for withholding consent of further reservation; but such an objection need not be too hardly pressed; for though the existing conditions of forest conservancy in Baluchistan preclude the possibility of immediate profit, the value of the State Forests, even from a purely pecuniary point of view, will increase from year to year; and it cannot be doubted that ultimately they will more than repay the cost of protection. And their importance in the general economy of the country; their influence on the permanency of local water-supplies; their value in the event of extended military operations; and many other points in favour of their careful preservation and improvement may well be held to counterbalance, and indeed far outweigh, all objections on the ground of present want of direct pecuniary profit. It may also be urged that continued delay in effecting the proposed reservation will not only accentuate existing difficulties, owing to growth of prescriptive rights, etc., but also must entail rapid diminution in the value of the forest tracts themselves."

Mr. Reuther is to be congratulated on having put the matter so clearly and it is very satisfactory that the agent, Sir James Browne, "concurs generally in the views expressed by the Deputy Conservator in this important matter." while the Government of India remark on them as follows:—

"So far the question of reservation has been simplified by the fact that the areas reserved have been almost free from rights of user. It appears, from Mr. Reuther's report, that the area suitable for forests of which this can be said has been practically exhausted, and that in bringing any further area under forest control, it will be necessary to provide for extensive rights of user. If it should be decided that, notwithstanding these rights, it is advisable to bring further portions of the Ziarat juniper tract under the forest law, the needs of the local population should be amply provided for on the lines laid down in Resolution No. 22-F., dated 19th October, 1894."

The remarks on 'Natural reproduction' are always likely to be interesting from such a country. This year it is pointed out how and why juniper seedlings of less than four years of age are so scarce, the last seed year was 1890-91, but the seedlings which then appeared were largely destroyed by locusts. *Prunus eburnea* seems to be the species from which most is to be expected as a fuel-wood.

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The financial results of the year were :—

	Revenue	Expenditure	Deficit
Forest year ...	21,395	63,829	42,434
Financial year ...	20,731	63,728	42,997

Of course the Baluchistan forests cannot be expected to pay for a long time to come.

The *Burma* Report shews that there were 9,642 square miles of Reserved Forest and 709 square miles of taungya area under the Department at the close of the year, giving 6 per cent only of the area of the Province, an area which seems to us to be rather small for a country like Burma, possessing huge forests of very great economic value in the present, and greater prospects still in the future. It is noticeable that the Government of India admit, in regard to Burma, that their Circular Resolution No. 22 of October, 1894, necessitates no change of policy in Burma. It seems to us that a good many Provinces are in the same way and that the Resolution would have caused less disturbance if it had been written for the Provinces to which it does apply, instead of being made general, necessitating great waste of time and labour in reporting on it.

The Tenasserim Circle Report records that the extraction of teak was in excess of that contemplated, and that the extraction of woods other than teak was less than was intended. The gross outturn of the Circle was :—

	Tons	Value, Rs.
Teak ...	16,565	2,75,828
Other reserved woods ...	8,870	72,398
Unreserved woods ...	24,253	40,392
Fuel ...	24,623	9,707
Bamboos ...	...	4,615
Canes ...	...	4,397
Minor produce ...	...	8,450

The Report of the Pegu Circle says that only teak trees which have died naturally or trees of large size are extracted, and discusses the question of reproduction in a paragraph from which we extract the following :—

“A further question presents itself—Is reproduction keeping pace with exploitation? Of late years over 1,200 acres have been planted annually, and if these areas were fully stocked, a final yield of 70 tons per acre or 84,000 tons in all might be expected; they are not fully stocked, but an outturn of 56,000 tons may reasonably be expected from 1,200 acres of taungya plantations of average density. As regards natural reproduction, it is believed that in dry forests it is at least keeping pace with exploitation, and that in moist forest it is an uncertain quantity; the area of dry forest is certainly not less than 1,000 square miles, on

which it may be assumed that natural reproduction is at least proportional to an exploitation of 6,000 tons. It may further be assumed that the removal of climbers and useless trees which is in progress in three divisions must to a certain extent encourage natural reproduction. It may be safely assumed therefore that reproduction is keeping pace with exploitation, but it is doubtful whether the former is much in advance of the latter. The Forest Department cannot remain content with an outturn of 6.6 tons only per square mile, and a much larger expenditure on reproduction, fire-protection and establishment seems advisable."

We are surprised that no mention is made of the possibility of getting a bamboo-seeding year and utilizing it fully for the reproduction of teak. We have heard otherwise that somewhere about 1893 or 1894 the 'Kyathaungwa' (*Bambusa polymorpha*) did seed in parts of the Pegu Circle but that no advantage was taken of the circumstance; but the present report only mentions that enquiries go to shew that it last flowered about 40 years ago both in the Arakan and Pegu Yomas. (Sir D. Brandis collected flowers in 1862 and Mr. S. Kurz in 1871). It is rather sad to hear that there was a plentiful reproduction of cutch but that most of the seedlings did not survive the first forest fire. The gross outturn of the Circle was:—

	Tons	Value, Rs.
Teak ...	52,933	19,90,706
Pynkado ...	23,336	121,947
Reserved woods ...	3,940	28,213
Unreserved woods ...	57,050	77,099
Fuel ...	94,732	41,666
Bamboos ...	...	43,714
Canes ...	...	12,330
Minor produce ...	...	25,004

The following account of the teak market of the year will be read with interest.

"The teak market in Europe has been steady almost throughout the period under review, the year closing at the rates quoted in the opening, namely, £9 to £10 for cargo timber and £9 to £10 10s. for Europe planks of usual market specification.

"There was an upward tendency late in 1893 in consequence of the annual purchases for the British Navy, but they failed to establish any permanent improvement, the demand for general ship-building being limited and railway requirements unusually restricted.

"The Continent and so-called "outports" have again absorbed quite 33 per cent. of the shipments to Europe, France taking off the usual quantity chiefly for naval purposes, whilst Germany, Italy, Russia, &c., continued to work off moderate quantities in the same direction. Endeavours to place teak in the United States, America, have not met with success.

Free supplies from Siam have resulted in very considerable shipments from Bangkok to Europe, and, although the price of Bangkok wood in the Home markets declined to only about £8, there are no signs of any diminution in Bangkok charters, and the competition of Bangkok wood is beginning to be felt severely by Burma shippers. The arrivals in Bangkok during the last floating season amount to nearly 65,000 logs against 72,000 logs in the preceding season."

In the Eastern Circle, Upper Burma, the gross outturn was:—

	Tons	Value, Rs.
Teak ...	152,121	13,41,100
Reserved woods ...	264	6,086
Unreserved woods ...	34,213	61,394
Fuel ...	79,392	39,893
Bamboos ...	...	29,062
Canes ..	...	2,775
Minor produce ...	...	1,66,895

We are interested to see that the tapping of *Pinus Kasya* for resin was attempted in the Southern Shan States with the result that 275 tons gave 374 viss of resin (17 maunds) at a cost of Rs. 224. The resin has been sent to England for trial, and we hope it will be approved, at the same time the cost of extraction must be greatly decreased, we are sure, if it is to be a profitable business, for even at the rather fancy rate of Rs. 7 per maund, such an experiment would have given a deficit of Rs. 105. We expect that the local market is the best thing to aim at, as there must be considerable demand for turpentine in Rangoon.

The notes on natural reproduction for the Eastern Circle record the flowering of the 'Myinwa' bamboo (*Dendrocalamus strictus*), of the 'Wapyuzan' (*Bambusa Oliveriana*) a new species, and of the 'thanawa' (*Thyrsostachys Oliveri*). The following account of reproduction in the Southern Shan States is interesting.

"The majority of the teak forests in the Southern Shan States consists of belts lying along the steep banks of narrow valleys below the *In* forest, which cover the hills and above the evergreen growth on the banks of the streams. In such forests the number of different species is large and the usual bamboo is myinwa. The reproduction is generally sufficiently good in spite of the steepness and rocky character of the ground. The myinwa flowers sporadically every year. In more open situations thanawa covers the ground and with teak forms the principal stock. This Bamboo flowers at long intervals and, though its cover is light, it takes entire possession of the soil, preventing the reproduction of teak. There are large areas of this class of forest, which it will be interesting to watch when the thanawa's time for flowering comes round. In the few places in which teak forest has an opportunity of spreading out over level ground, the stock of seedlings is generally sufficient in spite of annual fires. Old

'taungya clearings are often filled with young teak, which also establish themselves with great vigour on low lying alluvial ground in spite of severe fires.'

The Western Circle Report gives the gross outturn as follows :—

	Tons	Value, Rs.
Teak	53,669	5,01,280
Reserved woods	54	996
Unreserved woods	8,853	11,481
Fuel	8,338	3,064
Bamboos	...	20,588
Canes	...	4,700
Minor produce	...	1,12,646

The total financial results for Burma as a whole were :—

		<i>Forest year.</i>	<i>Financial year.</i>
Revenue	...	58,25,093	57,85,100
Expenditure	...	18,17,655	18,62,510
Surplus	...	40,07,438	39,22,590

A fine result, but what strikes us most about it is that with such results in the way of surplus revenue, surely greater success in, and the extension over larger areas of, fire protection, ought to be attained and much more money be spent on opening out communications, and in works of improvement. We can add that the total of the figures we have given for the circles, gives an outturn of 275,288 tons of teak 36,464 tons of reserved wood, 124,369 tons of unreserved woods, and 207,085 tons of fuel, the ton being, we presume, the nominal one of 50 c. ft. Besides this timber, bamboos were sold to the value of Rs. 97,979, canes to the value of Rs. 24,202, and minor produce, which includes cutch, to the value of Rs. 312,994. Such figures show conclusively the value of our forest estate in Burma and suggest that it must not be starved either in Officers or in funds and that, as before suggested, the area of reservation seems to require increase.

VI-EXTRACTS, NOTES AND QUERIES.

Oil of Turpentine.

Owing to the comparatively low value of petroleum, shale naphtha, and rosin spirit, these liquids are frequently used to adulterate the more valuable body-turpentine. Indeed, enormous quantities of so-called turpentine have recently been on the market which have contained large quantities of one or other

of these adulterants, and it is of the highest importance that the methods of examining this product should yield reliable results. In addition to the really adulterated turpentine in the market there are many so-called turpentine substitutes, sold under such fancy names as "turpenteen", which consist in the main of the bodies I have mentioned above. There are always many difficulties in examining turpentine, since there are several varieties of it which possess essentially different properties. The chief of these are French, English, or American, and Russian. The optical activity used to be regarded as a very definite test, as turpentine rotates the plane of polarisation, whilst none of its adulterants usually do so. The amount of rotation being fairly constant, any reduction was looked upon as indicating adulteration. But since French turpentine rotates the plane to the left and American and Russian to the right, it is clear that mixtures of these varieties might give natural results without the addition of any adulterant. The specific gravity, too, was once thought valuable, but in reality this will only indicate adulteration with petroleum spirit as the following figures show :—

Turpentine	... ·558 to ·878
Coal-tar Naphtha	... ·860 to ·875
Rosin spirit	... ·856 to ·880
Petroleum Naphtha	... ·700 to ·750

The flash-point is also valuable in showing any adulteration with ordinary petroleum naphtha. I have always found that in genuine samples this variety (taken by the official test in Abel's apparatus) from 92 degrees Fahr. to 98 degrees Fahr. The addition of 5 per cent of petroleum naphtha will lower this figure very considerably.

The residue, after drying on the water bath, does not exceed one per cent in the best samples, although in old samples it rises considerably. By far the most useful test, however, is the behaviour on distillation.

With petroleum spirit or rosin spirit the initial temperature of distillation varies greatly with the quality of the spirit and the temperature rises gradually without allowing any large quantity to come over at any specific temperature, with both of these adulterants a variable proportion of residue of very high boiling point is usually left in the still. The statements in most of the usual text books as to the behaviour of pure turpentine are by no means uniform, and I have obtained several samples of undoubted authenticity and examined them in this respect. The results are tabulated below, and may be relied upon as representing genuine samples :—

The Chief point of note is that American turpentine yields a heavy proportion of its distillate below 165 deg C., whereas the Russian oil distils at a slightly higher temperature. An examination to be as complete as possible should comprise all the factors I have mentioned in this note. I will conclude by quoting the figures

obtained from a somewhat remarkable sample of so-called turpentine, obtained from a very reputable source. They are as follows :—

Specific gravity	...	...	·9317
Residue	...	...	1·78 per cent
Flash-point	...	...	93·50 Fahr
Viscosity at 60 degrees Fahr	...	...	14 seconds

The gravity, residue, and viscosity were so elevated that I examined it by the distillation method. It turned out to be a mixture of turpentine, camphor, and water, evidently sent out in mistake. With so valuable a commercial product I cannot too strongly emphasise the necessity of carefully examining one's samples.

	No. I American Turpentine.	No. II. Russian Turpentine.	No. III. American Turpentine.	No. IV. American Turpentine.
Specific gravity	·8768	·8717	858	·867
Flash-point	95° Fahr	98° Fahr	39° Fahr	95° Fahr
Viscosity (Redwood) at 60 degree	27 seconds	26 seconds	...	26 seconds
Residue 100 degree C	1·6%	1·75%	...	0·62%
Bolling-point	312° Fahr	320deg Fahr	309deg Fahr	312deg Fahr
Fraction below	160° 46·5%	Nil	66 per cent.	92 per cent.
	165° 35·0%	32 per cent.	66 per cent.	92 per cent.
	170° 5·0%	35 per cent.	12 per cent.	1 per cent.
	175° 1·8%	15 per cent.	6 per cent.	...

(From "Indian Engineering"; an extract from the "Ironmonger.")

Shifting Sands.

A method of reclaiming sand wastes has been successfully carried out on the seashore of Wales, which may well be imitated by the states bordering on the Great Rajputana desert, as well as by those owning similarly situated lands in India. First, in order to reduce the force of the wind, a screen is erected, composed of a wire fencing, with twigs worked into a fascine along the wires. Behind this protecting fence or wattled wall, trenches 6 feet apart are dug and filled in with earth or loam to serve as beds for a plantation of timber trees. Between these trenches, seeds or cuttings of indigenous shrubs and grasses are placed. This forms the boundary of the waste taken up for reclamation. The land in the rear of this line is then filled up with trees and shrubs which are found to thrive luxuriantly in the neighbourhood.

In eight years time the piece of land thus treated was transformed into a well-timbered and thriving forest from an useless and unprofitable waste.

In Rajputana, "babul" may be placed in the trenches as a timber tree, whilst such shrubs as "peeloo" and tamarisk may fill up the intervening spaces as an undergrowth. The elephant or "secunder" grass may be used for the wattles and also be intermixed with the shrubs. All the above-mentioned trees, shrubs and grass have a marketable value and will not only repay the small outlay incurred but will eventually be a source of income. In Marwar, where each town is an oasis, the plan described above will enlarge the area under cultivation and in time change its climate by increasing the rainfall, so that any local undertaking of this nature will have a general and lasting effect in the country.

Managers of Railways, who are generally keen on matters affecting revenue, will do well to take advantage of a system which will supplement their earnings from grass grown on the embankments and at the same time reduce the maintenance of tracks in sandy districts.

Although artificial means have been employed to arrest sand-drifts, these are unproductive and therefore employed with reluctance whilst this system is without that drawback—(By 'Railway Engineer' in 'Indian Engineering').

Death of Professor Willkomm.

We see from the 'Forstlich-natur-wissenschaftliche Zeitschrift' for November 1895 that Professor Moritz Willkomm, the well-known author of the 'Forest Flora of Germany', Professor at the University of Prague and Director of the Botanic Garden at that place, died in Bohemia on August 21st last, at 75 years of age.

Dr. Grasmann.

Dr. E. Grasmann who has been for the last eight years Professor of Forestry in the University of Tokio, Japan, and who, the students of the 1st year of Coopers Hill will remember, accompanied them in 1887 on their tour in the forest of the Bavarian Alps, has given up his Japanese appointment and returned to Germany, where he has rejoined his appointment in the Bavarian State Forest Department.

The Turpentine-tree.

Botanical Name.—(*Syncarpia laurifolia*, Ten.)—Derived from two Greek words, *sun*, together, and *karpos*, a fruit, in allusion to the heads of fruits which have their calyces joined or grown together (connate).

without anyone being any the wiser. This pious fraud was, however, the mean of minimising the destructive effects of the fire.

Another instance of the substitution of turpentine for ironbark was not so happy. In a certain suburb some carters did a roaring trade in ironbark firewood at a rate very much below that ruling for ironbark. When the wood began to be used complaints were very general, for it would burn with difficulty. I found that the wood was turpentine, and that these enterprising carters had been clearing a turpentine paddock about 2 miles away. These incidents show that ironbark and turpentine bear some superficial resemblance, but substitution of one for the other should be detected by any careful man.

It is, perhaps, the best timber we have for piles, &c., for sea-water, as it is so resistant to the *Teredo* and other marine borers. This immunity is believed to be owing to the layer of oleo-resin between the bark and wood, which is distasteful to animal organisms, but we have no absolute experiments on this point. Turpentine piles are always driven with the bark on, as when stripped of their outer covering, they are by no means proof against the attacks of marine and other borers.

A pile was exhibited at the Colonial and Indian Exhibition of 1886, taken from a jetty at Brisbane Water, near Sydney, where it had been fully exposed to the waves of the Pacific Ocean for twelve years. It had been entirely unprotected, yet on cutting it through it was found to be perfectly free from decay, and from the attacks of the *Teredo*. I am informed that piles of this timber have been known to remain sound, even for thirty years, in sea-water. It is also very durable in fresh water.

The Hon. W. Pettigrew, a Queensland timber merchant, however, states :—"This timber was said to be capable of resisting the cobra, and thereby a great value was set on it by the Government, yet when tested by the Harbour-master at Brisbane, it has been found that such not the case, as specimens on the table will show." I give this statement of a gentleman of high reputation in colonial timbers on the principle that, advocate as I am for their use, I always draw attention to any defects I may know them to have. It is, however, so opposite to my direct personal observation, that I trust readers of the *Gazette* will come forward with their testimony in regard to the durability of the turpentine in sea-water.

It is very resistant to white ant, but it must be remembered that no timber is absolutely white-ant proof, as white ants, if put to it, will probably eat any timber on the face of the globe.

It is said to be comparatively soft and brittle, but perhaps there is some mistake in this, as I have always found it to be as hard as the average myrtaceous timbers, and it is not brittle when

the sap-wood is removed. In Professor Warren's work on Australian timbers there are a number of tests as to the strength of this timber to which I desire to refer my readers.

Like many other myrtaceous timbers, such as myrtles, turpentine is very liable to rend in drying. It also warps when much exposed, unless seasoned with unusual care; this is a drawback to its use for uprights in buildings.

Size.—From 120 to 180 feet is no uncommon height for this tree to attain. It often measures 20 to 30 feet in circumference with great length of bole, but such magnificent specimens are, within easy range of Sydney, usually found in gullies difficult of access.

Distribution.—The return gives valuable information concerning turpentine, and is a guide to the distribution of this timber. I may mention that it extends throughout the coast districts from the Tweed to the Ulladulla district, arriving at its greatest luxuriance in deep gullies containing good soil, in which situations it is found a considerable distance inland into the mountains and table-lands. The southernmost tree known at present is at the head of the Cockwhy Creek, between Ulladulla and Bateman's Bay. It is also found in Queensland. Its occurrence is usually a sign of good soil.

Propagation.—From seed, which is very freely produced. This tree is one of the best indigenous shade-trees in the Colony. It is gregarious, and its noble, leafy head makes it an ideal tree under which to put garden seats, or to serve as shelter-trees for men or animals in a paddock, or as specimen trees, to give a park-like appearance to land. It is one of those trees that should always be spared, in clearing operations, unless its room is actually wanted. It is so different in appearance to the ordinary run of gum-trees that the occurrence of turpentines is often a relief to the eye. My experience tends to show that turpentines have a large number of roots near the surface, which, if disturbed, readily kill the tree. I would not, however, like to generalise on this point. I have seen some experiments on pollarding the turpentine. The trees were cut in the month of May, and have freely sent forth leaf-buds a considerable distance down the trunk, giving the tree quite an ornamental appearance. Where a tree is growing too large, and it is not necessary to absolutely remove it, the experiment I have indicated might be made.—(J. H. Maiden—*Agricultural Notes*, N. S. W.)

Note.—(This tree is well known in the Nilgiris where it grows well and could easily be more largely propagated.)

HON. ED,

Churchill and Sim's Circular,

1st January, 1896.

East India Teak.—The importation of Timber and Planks has been—

	1889.		1890.		1891.		
Importation.	19,407 Loads	...	16,000 Loads	...	16,588 Loads		
And the deliveries	15,899	"	17,140	"	14,371		
	1892.		1893.		1894.		1895.
Importation.	7,923 Loads	12,687 Loads	9,849 Loads	22,200 Loads			
And the deliveries	10,455	"	12,646	"	10,620	"	18,399

The Teak trade in London has been a curious one in 1895; full of probabilities of great change which have not been realised. The greatly increased quantity of the wood which has been landed in the docks might have sent the market to the lowest depths it has seen for five years past; or the great increase in its consumption might have raised it higher than has ever been known. In the event these forces have neutralised each other, and the market has remained immovable at one steady level from January to December. This is not altogether satisfactory, for the level is a low one, and there have been in the past year so many causes operating all over the world in favour of this most political of woods, that the extra supply produced should have been something more than neutralised by them if the general demand had shown any elasticity. The labour troubles at the Scottish and Irish shipbuilding ports have probably checked that elasticity just at the critical moment; if they could be settled before it is too late there would be every prospect of a gradually improving market for Teak in the new year. In the matter of quality, the imports of the period under review have maintained their high reputation, and some of the best wood now in the docks has come from Siam. The figures of the year's trade have been largely swelled on both sides by Navy requirements brought here for approval and selection before delivery to the Dockyards.

SATINWOOD.—East India.—There was a marked increase in the import of *logs*, but the scarcity of large and figury wood from the West Indies enabled the bulk to be sold at good prices, and there is now only a small stock on hand, but the principal enquiry is for figury wood: a few parcels of *boards* were sent in, and being more or less figury they brought very fair prices. Quotations for logs are from 1d. to 12d., and for planks and boards from 9d. to 12d. per foot.

ROSEWOOD.—East India—was shipped more freely, but chiefly in small lots, most of which were placed at satisfactory prices; as, however, the consumption is not large, supplies must be kept strictly moderate or prices would soon suffer. There is sufficient stock for present requirements. Quotations are from £6 to £10 per ton.

EBONY.—Ceylon.—The import, although not heavy, was still considerably in excess of the previous year, and was chiefly of a rather poor character, it therefore only found buyers slowly and at low prices. There was a constant demand for prime, large logs, but none were imported; this demand still exists and a suitable shipment would sell well; most of last year's import was sold, but there is quite enough ordinary wood on hand to meet current wants. Quotations are from £6 to £8 for ordinary to fair, and from £10 to £15 per ton for good to prime logs, of large sizes. East India.—Shipments were again limited to two small parcels; the first sold well, but the second remains on hand, as the demand recently has been rather quiet. Sound logs, of good sizes and colour might be sent, but only in small lots. Quotations are from £6 to £8 per ton.

PADOUK.—The heavy stock brought forward was materially increased by a large cargo, which arrived in July. The absence of any improvement in the export demand, or in home consumption, not only prevented any reduction of stock, but caused a heavy accumulation, which, unless an unexpectedly large demand arises through the scarcity of Mahogany, it will take a long time to clear. Quotations are from 2s. 6d. to 3s. per foot cube for planks and logs.

CEDAR.—The only shipment from Malabar (9 logs) came in when the market was very dull, and although the logs were of good sizes they were in poor condition and realised low prices. As this quality is not much appreciated, only large, sound, light-coloured wood is likely to give satisfactory results. Quotations are quite nominal at from $\frac{1}{2}$ d. to 4d. per foot.

MARKET RATES OF PRODUCTS

Tropical Agriculturist, December, 1896.

Cardamoms	per lb.	1s. 10d.	to	2s. 8d.
Croton seeds	per cwt.	50s.		
Cutch	"	20s.	to	30s.
Gum Arabic, Madras	"	12s. 6d.	to	50s.
Gum Kino	"	£25	to	£30.
India Rubber, Assam,	per lb.	1s. 7d.	to	2s. 2d.
" Burma	"	1s. 6d.	to	2s. 2d.
Myrabolams, Bombay,	per cwt.	7s. 6d.	to	7s. 9d.
" Jubbulpore	"	6s. 3d.	to	7s.
" Godavari	"	5s.	to	5s. 6d.
Nux Vomica, good	"	6s.	to	9s.
Oil, Lemon Grass	per lb.	2½d.		
Orchella, Ceylon	per ton.	11s.	to	15s.
Redwood	"	£4	to	£4 10s.
Sandalwood, logs	"	£30	to	£50
" chips	"	£4	to	£8.
Seed lac	"	50s.	to	100s.
Tamarind	"	9s.	to	11s.

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[No. 3]

Weight and Strength of Travancore Timbers.

I have been making some experiments during the last year or two to test the strength and weight of some of our South Indian timbers, and as the Christmas holidays have given me the opportunity of tabulating my figures and notes, it has occurred to me that you may care to have the result of these experiments for publication in your Journal.

The value of P as given below was obtained by suspending weights to the middle of battens 2 ft. by 1 in. by 1 in until they broke, the distance between the supports being 22 inches. Two specimens of each species were tested within six months of felling the trees from which they were cut, and generally four specimens more were similarly tested after a year from the time of felling. The value of P is in most cases, therefore, the average of 6 specimens.

The weight obtained is the average of about 3 specimens of each species, the number weighed varying from 1 to 5. All these specimens were dried for 12 months before weighing.

This method of testing the breaking strain has brought into prominence the importance of seasoning timber destined to sustain a weight. In 91 per cent of the species tried, the value of P increased during seasoning, and in 9 per cent its value either remained unaltered or declined. In several instances, this decline was due to the boring of the wood by beetles or to the wood itself perishing, but as a rule all the better kinds of timber greatly improved by keeping.

The average improvement of all the species which improved in strength was 43 per cent., the decline of those that deteriorated averaged 8 per cent and the average general improvement was 38.4 per cent, a very remarkable result considering that it was the outcome of only six months seasoning.

This conclusion is opposed to the ordinary native idea that timber when thoroughly dried, or "dead" as they call it, is

useless. This idea no doubt originated in the fact that when timber is dry it snaps more suddenly and with less warning than when fresh cut in spite of its greater strength.

It is not claimed that the figures given below would always remain constant for the same species. The strength, and, to a less degree, the weight of specimens, even when cut out of the same tree, vary within wide limits, and all that can be said is that by taking the averages of a large number of specimens it is possible to ascertain the relative strength and weight of the different species tried.

T. F. BOURDILLON.

QUILON, }
27th January, 1896. }

PROPERTIES OF CERTAIN TRAVANCORE WOODS.

Name.	Value of P.	Weight per cubic ft.	Remarks.
Dillenia pentagyna.	554	44	Hard, reddish-brown, poor.
Polyalthia fragrans.	567	41	Hard, pale yellow, used for masts.
Xylopia parvifolia.	725	44	Moderately hard, greyish white, not used.
Miliusa velutina.	847	50	Ditto ditto yellow, used for shafts, etc.
Bocagea Dalzellii.	788	49	Hard, pale yellow good.
Cratæva religiosa.	279	28	Very soft, greyish white. useless.
Flacourtia Cataphracta.	811	56	Very hard, purplish yellow.
Hydnocarpus Wightiana.	• 464	38	Soft, greyish white, useless.
Xanthophyllum flavescens.	567	48	Moderately hard, pale yellow, too small for use.
Garcinia Cambogia.	608	47	Ditto ditto pale grey, coarse.
Calophyllum Wightianum.	579	44	Ditto ditto reddish brown, good.
Mesua ferrea.	951	60	Extremely hard, red, used for building.
Gordonia obtusa.	533	40	Hard, elastic, pale brown, good but not used.
Dipterocarpus indicus.	695	47	Hard, greyish red, useful for building.
Hopea glabra.	857	68	Very hard, pale brown, good but small.
Vateria indica.	415	36	Rather soft, pale brown. coarse.
Bombax malabaricum.	519	29	Very soft, greyish white, perishable, used for tea boxes.
Cullenia excelsa.	508	34	Rather soft, pale brown, perishable.
Pterospermum rubiginosum.	...	40	Extremely hard, bright pink and very handsome.
P. Heyneanum.	603	43	Moderately hard, reddish brown, good.
Grewia tiliaefolia.	766	46	Moderately hard, pale brown. elastic, used for tool handles..
Elæocarpus serratus.	508	33	Rather soft, greyish white, bad.
Canarium strictum.	523	35	Soft, greyish white, perishable.
Filicium decipiens.	902	59	Extremely hard, red, good but small.
Melia dubia.	391	26	Soft, coarse, pale red, suitable for rough planking.

Properties of certain Travancore Woods.—(contd.)

Name.	Value of P.	Weight per cub ft.	Remarks.
<i>Dysoxylum malabaricum.</i>	...	45	Hard, straight grained and elastic much used for oil casks.
<i>D. Sp.</i>	708	52	Hard, reddish brown, not used.
<i>Aglaia Roxburghiana</i>	898	57	Very hard, dark red, useful for spokes of wheels.
<i>A. Sp.</i>	961	45	Hard, yellow, sweet scented but of small size.
<i>Walsura Piscidia.</i>	947	59	Very hard, greyish brown, not used.
<i>Cedrela Toona.</i>	349	29	Soft, pale red, shining, sweet scented, used for Cigar boxes.
<i>Gomphandra axillaris.</i>	358	30	Soft, grey, perishable, very poor.
<i>Lophopetalum Wightianum</i>	467	30	Moderately hard, white, useful for planking.
<i>Kurrimia paniculata.</i>	505	40	Hard, greyish brown, not used.
<i>Schleichera trijuga.</i>	725	66	Extremely hard, pinkish brown, cross-fibred, used for oil-mills.
<i>Nephelium Longana*</i>	1061	61	Ditto ditto, brown, good for building
<i>Turpinia pomifera.</i>	398	27	Rather soft, grey and useless.
<i>Meliosma simplicifolia.</i>	370	31	Very soft, greyish brown, very bad.
<i>M. Arnottiana.</i>	325	21	Soft, pale brown, very poor.
<i>Mangifera indica.</i>	399	41	Soft, greyish white, coarse, used for planking.
<i>Gluta travancorica.</i>	...	53	Very hard, bright dark red, brittle, but good for furniture.
<i>Buchanania latifolia.</i>	452	36	Hard, greyish white, coarse.
<i>Odina Wodier.</i>	673	60	(Heart only) moderately hard, pinkish brown, good for furniture.
<i>Anacardium occidentale.</i>	317	30	Soft, pale grey, coarse and worthless.
<i>Semecarpus Anacardium.</i>	230	35	Hard, coarse, brownish grey & useless.
<i>S. travancorica.</i>	425	28	Very soft & coarse, greyish white and useless.
<i>S. auriculata.</i>	404	28	Do. do. do. do.
<i>Holigarna Arnottiana</i>	343	27	Soft, greyish white, coarse & useless.
<i>H. Sp.</i>	418	32	Do. do. do. do.
<i>Spondias Mangifera.</i>	293	22	Extremely soft, greyish white, perishable and very bad.
<i>Pongamia glabra.</i>	...	49	Moderately hard, coarse, yellow streaked with grey, not used.
<i>Hardwickia pinnata</i>	640	46	Hard, elastic, dark reddish brown, used for planking.
<i>Bauhinia malabarica.</i>	563	56	Very hard, dark brick red to claret coloured.
<i>Xylia dolabriformis.</i>	...	59	Extremely hard, dark brown, much used for building.
<i>Albizia odoratissima</i>	627	38	Hard, pale brown, smooth. Useful.
<i>A. procera.</i>	738	45	Hard, dark brown, useful for building
<i>A. stipulata.</i>	666	27	(Heart only) Soft, pale brown, coarse.
<i>Pygeum Wightianum</i>	622	44	Moderately hard, pink, even.
<i>Carallia integerrima.</i>	700	47	Do. do. yellow, prettily mottled.
<i>Blepharistemma corymbosum.</i>	574	42	Do. do. greyish yellow, rather rough.
<i>Terminalia Belerica.</i>	720	42	Hard, yellowish grey, coarse, used for boats and building.

Properties of certain Travancore Woods.—(contd.)

Name.	Value of P.	Weight per cub ft.	Remarks.
<i>T. paniculata.</i>	636	57	Hard, pale brown, useful for building.
<i>Auogeissus latifolia.</i>	863	58	Heart very hard, dark purplish brown sapwood thick, white, coarse but strong.
<i>Eugenia Arnottiana.</i>	594	56	Hard, dark greyish brown, coarse.
<i>E. lutea.</i>	739	55	Very hard, yellowish brown, coarse.
<i>E. montana.</i>	489	44	Moderately hard, pale brown mixed with patches of yellow, used for building.
<i>E. Sp.</i>	830	52	Hard, reddish brown, coarse.
<i>E. Sp.</i>	675	42	Do. greyish brown, coarse.
<i>E. Sp.</i>	768	52	Do. do. do. do.
<i>Careya arborea.</i>	582	65	Very hard, dark reddish brown, warped
<i>Memecylon edule.</i>	851	58	Very hard, yellowish brown, fine grained but liable to cracks.
<i>Lagerstroemia lanceolata.</i>	596	43	Moderately hard, pale brown, straight grained, much used.
<i>L. Reginae.</i>	500	41	Do. do. reddish brown, useful
<i>Tetrameles nudiflora.</i>	321	21	Very soft and coarse, greyish white, used for boats.
<i>Mastixia pentandra.</i>	331	28	Soft, yellowish grey, bad.
<i>M. arborea.</i>	452	32	Moderately hard, greyish yellow, poor
<i>Adina cordifolia.</i>	...	43	
<i>Stephegyne parvifolia.</i>	656	39	Moderately hard, yellowish pink, good.
<i>Nauclea Missionis.</i>	430	37	Do. do., bright yellow and prettily marked, an ornamental wood, but not strong.
<i>Hymenodictyon excelsum.</i>	447	28	Very soft. greyish white, poor.
<i>Webera Sp.</i>	...	61	Extremely hard, pinkish brown, smooth but small.
<i>Randia Sp.</i>	785	53	Moderately hard, pale brown, even.
<i>Canthium Sp.</i>	870	48	Do. do. do. do. good.
<i>Ixora Sp.</i>	628	55	Very hard, reddish brown, good.
<i>Chrysophyllum Roxburghianum.</i>	476	36	Soft, greyish white, coarse and poor.
<i>Dichopsis elliptica.</i>	472	44	Hard, reddish brown, straight grained, much used for shingles.
<i>Bassia malabarica.</i>	471	51	Hard, brownish red, of small size.
<i>Diospyros Ebenum*</i>	1160	69	Extremely hard, jet black, very good.
<i>D. microphylla.</i>	643	49	Hard, brownish grey, straight & good.
<i>D. nilagirica.</i>	605	44	Moderately hard, yellow, no black heart.
<i>D. Sp.</i>	445	46	Hard, white and grey in irregular patches, no black heart.
<i>Symplocos macrocarpa.</i>	455	31	Moderately hard, white & smooth.
<i>Alstonia Scholaris.</i>	416	27	Very soft & perishable, coarse, white.
<i>Wrightia tomentosa.</i>	390	34	Soft, yellowish white mixed with patches of grey.
<i>Tabernaemontana Sp.</i>	391	33	Moderately hard, pale grey & white mixed.
<i>Stereospermum chelonoides.</i>	772	42	Moderately hard, greyish brown, mottled.
<i>S. xylocarpum.</i>	785	42	Hard, reddish brown & good, used for furniture.

Properties of certain Travancore Woods.—(contd.)

Name.	Value of P.	Weight per cub ft.	Remarks.
<i>Gmelina arborea.</i>	523	35	Moderately hard, greyish white, good.
<i>Vitex altissima.</i>	784	60	Do. do. yellowish brown, smooth and good, used for building.
<i>Myristica laurifolia.</i>	356	34	Soft, strawcoloured, perishable.
<i>M. malabarica.</i>	460	34	Soft, yellowish brown, perishable.
<i>M. magnifica.</i>	375	30	Do. yellowish white, do.
<i>M. Farquhariana.</i>	409	34	Do. yellowish grey, do.
<i>M. attenuata.</i>	514	35	Do. pale brown, do.
<i>Cinnamomum zeylaicum*</i>	593	37	Moderately hard, scented, brown and coarse.
<i>Machilus macrantha.</i>	408	36	Do. do., coarse, pale brown, used for boats.
<i>Bridelia retusa.</i>	548	61	Hard, brownish white, good.
<i>Phyllanthus Emblica.</i>	514	42	Very hard, dark red.
<i>Hemicyclia lanceolata.</i>	527	57	Very hard, pale brown, liable to crack.
<i>H. venusta.</i>	726	51	Moderately hard, pale grey, cracks.
<i>Bischofia javanica.</i>	745	52	Hard, dark claret red, very good.
<i>Aporosa Lindleyana.</i>	515	38	Very hard, white and close grained, small.
<i>Baccaurea courtalensis.</i>	569	42	Moderately hard, yellowish white, small.
<i>Mallotus philippinensis.</i>	631	44	Hard, brownish grey, small.
<i>Macaranga Roxburghii.</i>	403	27	Soft, pale brown, coarse & perishable.
<i>Trema orientalis.</i>	297	30	Moderately hard, dirty white, coarse and perishable.
<i>Ficus asperima.</i>	245	24	Very soft & perishable, brownish grey.
<i>Artocarpus integrifolia.</i>	...	33	Hard, bright yellow, much used for furniture.
<i>A. Lakoocha.</i>	577	43	Moderately hard, yellowish brown, good.
<i>A. hirsuta.</i>	573	35	Do. do. yellowish brown, smooth, much used for building.

* Only seasoned specimens tested.

Symbiosis and its effects on the Planting of Forest Trees.

We have recently been reading the "Natural History of Plants" by Professor Kerner von Marilaun of the University of Vienna and translated by Mr. F. W. Oliver, of University College, London, an exceedingly interesting and important work of the greatest interest to botanists and indeed to all who are lovers of Natural History or engaged in work which, like Forestry, has so much connection with vegetable life and plant physiology. The chapter on the subject of Symbiosis has especially attracted our attention and we are sure that Professors Kerner and Oliver will

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forgive our quoting a long extract from it and reproducing a copy of one of their figures. The point of chief importance to us lies towards the end where it is shewn that certain trees, and especially Coniferæ, Cupuliferæ (the oak, chestnut, beech, hazel, hornbeam and birch) and Salicacæ (willows and poplars) are dependant for their nutrition on the assistance of the mycelia of species of fungi which clothe their root caps. It seems to us that an important lesson which forest officers have to derive from this is that in planting young trees of these species *every precaution* ought to be taken not to remove the earth from about the roots, otherwise the fungus mycelium is apt to be dried up or rubbed off and the planting will fail. In order, therefore, to transplant successfully such trees as the deodar, kail, chir, the firs, and the oaks, recourse must be had either to planting out seedlings from pots or baskets, or to lifting the plants carefully with large balls of earth around the roots. Another point which clearly also requires to be attended to, is the choice of planting sites in localities where the trees are likely to find favourable conditions of soil for the propagation of the fungi with the assistance of whose mycelium they can only manage to thrive. Doubtless, too, among tropical and semi-tropical trees which we are called upon to propagate, there must be many whose life history has not yet been sufficiently studied for it to be known whether they can exist without fungal help so that wherever planting has to be done it will usually be best to assume that such help is required and that the transplanting must not be done without great care being taken not to denude the roots of their earth covering. The advantage of the use of baskets for planting is thus evident and the absence of care to preserve earth round the roots may account for much of the failure which has attended the Departmental endeavours to rear trees on waste lands in India. The following is the extract to which we refer. We are sure that it will be read with much interest.

"Another instance of Symbiosis is observed to exist between certain flowering plants and mycelia of fungi. The division of labour consists in the fungus-mycelium providing the green-leaved Phanerogam with water and food-stuffs from the ground, whilst receiving in return from its partner such organic compounds as have been produced in the green leaves.

'The union of the two partners always takes place underground, the absorbent roots of the phanerogam being woven over by the filaments of a mycelium. The first root that emerges from the germinating seed of the phanerogamic plant destined to take part in the association descends into the mould still free from hyphæ; but the lateral roots and, to a still greater extent, the further ramifications, become entangled by the mycelial filaments already existing in the mould or proceeding from spore-germs buried there. Thenceforward the connection continues until

death. As the root grows onward, the mycelium grows with it, accompanying it like a shadow, whatever its course, whether the root descends vertically or obliquely, and runs horizontally, or re-ascends, as is sometimes necessary when it happens to be turned aside by a stone. The ultimate ramifications of the roots of trees a hundred years old, and the suction-roots of year-old seedlings, are woven over by mycelial filaments in precisely the same manner. These mycelial filaments are always in sinuous curves and intertwined in various ways, so that they form a felt-like tissue, which looks, in transverse section, delusively like a parenchyma. As regards colour, the cell-filaments are mostly brown, sometimes they are almost black, and it is rare for them to be colourless. The epidermis of many roots is covered as if by a spider's web, whilst the hyphæ form a complex tangle of bundles and strands broken here and there by open meshes through which the root is visible. In other cases an evenly woven but very thin layer is wrapped round the roots; and in others, again, the fungus mantle forms a thick layer which envelops uniformly the entire root (see fig.). Here and there the hyphæ insinuate themselves also inside the walls of the epidermal cells, and the latter are permeated by an extremely fine small meshed mycelial net (see fig.). Externally the mantle is either fairly smooth, and clearly marked off from the environment, or else single hyphæ and bundles of hyphæ proceed from it and thread their way through the earth. When these branching hyphæ are pretty equal in length they look very much like ordinary root-hairs. And they not only resemble them, but assume the function of root-hairs. The epidermal cells of the roots, which would in an ordinary way act as absorption-cells, being inclosed in the mycelial mantle, cannot exercise this function and have relegated the business of sucking in liquid form from the ground to the mycelium. The latter undoubtedly acts as an absorptive apparatus for the partner on whose roots it has established itself; and the water in the soil, together with all the mineral salts and other compounds dissolved in that water, are caused by the mycelial mantle to pass from the surrounding ground into the epidermal cells of the roots in question, and thence onward, ascending into axis, branches, and foliage.

Thus the fungus mycelium not only inflicts no injury on the green leaved plant by entering in connection with its roots, but confers a positive benefit, and it is even questionable whether a number of green leaved plants could flourish at all without the assistance of mycelia. The experience gained in the cultivation of those trees, shrubs, and herbs, which exhibit mycelial mantles on their roots, does not, at any rate, lead to that conclusion. Every gardener knows that attempts to rear the various species of winter-green, the bog-whortleberry, broom, heath, bilberries, cranberries, the spurge laurel, and even the silver fir and the

'beech, in ordinary garden soil, are not attended with uniform success. Therefore, as is well known, soil consisting of vegetable



1. Roots of the White Poplar with mycelial mantle. 2. Tip of a root of the Beech with closely adherent mycelial mantle $\times 100$ (after Frank.) 3. Section through a piece of root of White Poplar with the mycelium entering into the external cells $\times 480$.

'mould from the top layer of earth in woods or on heath is chosen for the cultivation of the genera *Erica*, *Daphne*, and *Rhododendron*. But it is not even every kind of forest or heath mould that can be made use of. When earth of that nature has been quite dry a long time it is no longer fit for this purpose. On the other hand, it is known that the above mentioned plants should be transplanted from their forest home with the soil still clinging to the roots, and it is also laid down as an axiom that the roots of these plants should not be exposed and should be cut as little as possible. The following reason accounts for all this. Firstly—Fresh earth from the heath, or mould recently dug from the ground in a wood contains the mycelia still alive, whereas in dry humus they are already dead; secondly, the mycelia woven round the roots are transferred together with the balls of earthy matter suspended to them into the garden; and lastly, any considerable clipping of the roots would remove the ultimate ramifications which are furnished with the absorbent mycelial mantle.

'The failure of all attempts to propagate the oak, the beech, heath, rhododendron, winter green, broom, or spurge-laurel, by slips or cuttings, if the shoot which is cut off and used for the purpose, is put into pure sand, is explicable in the same way. Limes, roses, ivy, and pinks, the roots of which possess no

'mycelial mantle, are notoriously propagated very easily by putting branches out from them into damp sand. Rootlets are at once produced on those parts of the branches which are buried in the sand, and their absorption-cells carry on the task of taking up nutriment from the ground. But though cuttings of oak, rhododendron, winter green, bog-whortleberry, and broom strike root, no progress in their development is to be observed, because the superficial cells of the rootlets, in these cases, have not the power of absorbing food when they are not associated with a mycelium. It is only when the slips from these plants are put into sand with a rich admixture of humus, the latter having just been taken from a wood or heath and containing the germs of mycelia, that some few are successfully brought to further development. The result is even then often not assured, and the cuttings of several of the plants enumerated die even in sand mixed with humus before they have produced rootlets.

'Seeing also that the result of attempts to rear seedlings of the beech and the fir in so-called nutrient solutions, where there could be no question of union with a mycelium, has been that the plantlets dragged on a miserable vegetative existence for a short time and ultimately died, we have good grounds for assuming that the envelope of mycelial filaments is indispensable for the Phanerogams in question, and that the prosperity of both is only assured when they are in social alliance.

'The facts ascertained in cases of analogous relationship led one to expect that the fungus mycelia also derives some advantage from the flowering-plants, the roots of which they clothe, and to which they render the service of acting as absorption-cells. The benefit in question is undoubtedly the same as that derived by the hyphæ of a lichen-thallus from the enwoven green cells. The mycelial mantles withdraw from the roots of the Phanerogams the organic compounds which have been elaborated by the green leaves in the sunshine above ground, and which are conducted thence to all growing parts, that is to say, downwards as well as in other directions, to the tips of the swelling and elongating roots. According to this, therefore, the division of labour between the members of the alliance for joint nutrition consists in the mycelium supplying the green leaved plant with materials from the ground, and the green leaved plant supplying the mycelium with substances which have been worked up above ground in the sunlight.

'The range of species which live in a social union such as is here described is certainly very large. All *Pyrolaceæ*, *Vacciniæ*, and *Arbutæ*, most, if not all, *Ericaceæ*, *Rhododendrons*, *Daphnoidæ*, and species of *Empetrum*, *Epacris*, and *Genista*, a great number of Conifers, and apparently all the *Cupuliferæ*, as well as several willows and poplars, are dependent for nutrition on

'the assistance of mycelia. We find, too, that this condition recurs
'in every zone and in every region. Roots of the *Arbutus* on the
'shores of the Mediterranean are equipped with a mycelial mantle
'in precisely the same manner as those of the low-growing whort-
'leberry of the High Alps.

'Special importance is given to the social life by the fact that
'the chief species of Phanerogams participating in it are of gre-
'garious growth and cover whole tracts of country, forming
'boundless heaths and measureless forests, as, for instance, the
'various heaths, the oak, the beech, the fir, and the poplar. The
'conception of this subterranean life affecting every moorland and
'vast timbered tract is one full of wonder and interest.

'We can now see why it is that the ground in woods is the
'abode of such a profusion of fungi. No doubt some of these
'fungi draw their nutriment exclusively from the store of dead
'plant-organs accumulated there ; but others, as certainly, are in
'social connection with the living roots of green leaved plants. It
'is true we cannot yet state precisely what are the species of fungi
'which contract this sort of union, whether generally a definite
'elective affinity exists between certain fungi and certain green
'leaved plants. There is much in favour of this supposition in a
'few cases ; but on the other hand, it is very unlikely that each of
'the various Phanerogams occupying a limited area of ground in
'a pine-forest, where a few square metres of earth contain so many
'tangled roots belonging to pines, spurge laurels, bilberries, cran-
'berries, heath and winter green, that they can only be separated
'with difficulty, should select from the great host of fungi growing
'in the forest a different partner. In instances of this kind it seems
'just to suppose that the mycelium of one and the same species of
'fungus enters simultaneously into connection with all or several
'of the plants growing close together ; it is similarly probable
'that the mycelia of different species of fungi render to one and the
'same flowering plant the service of absorption according to the
'locality in which it occurs. This surmise is supported by the
'fact that when certain species, brought from distant parts and
'regularly exhibiting mycelial mantles on the ends of their roots,
'reared in our gardens and greenhouses from seed, they unite in
'these abodes with fungus-mycelia, which certainly do not exist in
'the regions where the Phanerogams in question grow wild.
'Thus, for instance, the roots of the Japanese tree, *Sophora*
'*Japonica*, and those of the *Epacrideæ* of Australia, are found in
'European gardens in social union with fungi, which with us are
'native, but which certainly do not occur in Japan or Australia ;
'and it is therefore scarcely open to doubt that the *Sophora*
'*Japonica* to take one example, associates itself with different
'fungi in different regions.

Savannah Forests in Bengal.

In the recent review of the Bengal Administration Report for 1893-94 a note of mine on the burning of savannahs in Jalpaiguri is reproduced. Might I point out that the accidental substitution of 'They' for 'The' in the seventh line considerably alters the meaning.

As the subject of savannahs is an interesting one, I would like, with your permission, to make a few further remarks *re* your comments on page 23.

There is, I believe, no doubt at all that the 'lowland' savannahs will not produce sal. Indeed I would define a lowland savannah in the Jalpaiguri district as ground too water-logged to grow sal but containing long grass.

The matter of the Savannahs on high land cannot, in my opinion, be so easily disposed of.

The Western Duars has *apparently* been hitherto an uninhabited waste consisting of patches of forest of more or less extent and vast seas of grass-covered land, which lands have only been in a process of conversion to cultivation during the few decades of British rule.

The grass-covered lands then, or—as we now call them—Savannahs, are held to be original, and existing practically since the Duars has presented its present physical aspect.

Taking this view of the case, the natural conclusion is that sal would only grow with difficulty on such lands.

Now, I believe that it is historical that before the possession of the Duars by the Bhotanese, the State of Cooch Behar held all the land up to the foot of the hills, and if so, it is quite reasonable to suppose that they held much of it under cultivation. Whether this is so or not, there is various evidence on the ground that much of the country has been under cultivation where now is only grass. In the largest of all the savannahs extending south of Chamrehi, not less than 100 sq. miles in area, and in which the Muraghat forest in reality forms only patches of sal, I have found abundant signs of old cultivation. Among these are old wells and species of trees planted by Bengali cultivators near their villages, such as jack, bael and kamranga (*Averrhoa Carambola*). There are moreover signs of permanent, not shifting cultivation, such as the Mechis and Garos even now practise, and which converts annually large tracts of tree-covered land into savannah. I have never seen those trees planted by shifting cultivators. On the old maps of 1863, too, we find the sites of villages marked in what is now reserved forest.

My contention then is : if so much of the land has once been under cultivation and there is reason to suppose that the cultivators avoided virgin forest soil, why should not much of what is now

high land savannah have been under sal forest, and have become what it is through the agency of cultivation and its concomitant, fire? And if the land has once grown sal, why should it not do so again?

Further, in many of the high land savannahs we actually find old sal stumps and isolated living trees of by no means 'poor physique' and all stages can be found between a complete sal forest and a complete savannah.

As far as my knowledge of them at present permits, I would classify high land savannahs, *i. e.* those not in evident depressions, as follows:—

1. Land that never grew sal forest, the water being too far below the surface: the previous existing forest probably of *Lagerströmia*, *Stereospermum*, *Sterculia*, *Callicarpa*, *Dillenia*, *Albizzia*, *Premna*, &c..

2. Land that never grew sal forest, the water being too near the surface, soil usually stong: Characteristic (?) grasses being *Andropogon*, *Anthistiria arunadinacea* and *A. gigantea*.

3. Land that did and can only grow poor sal: soil heavy; characteristic (?) grasses now being *Saucharum procerum* and *S. spontaneum*.

4. Land that can grow sal forest and probably did: the characteristic grass being now *Sauharum Nirengi*.

With regard to the departmental burning of savannahs, Sir D. Brandis's proposals, as far as I have always understood them, were purely tentative and were meant to be superseded as soon as possible by complete protection of the whole forest. In fact as far as I remember, not having his "Suggestions" before me, he at once proposed complete protection for certain forests. I contend that if sufficiently early burnings are regularly annually carried out, the sal would slowly spread into a savannah of my type number 4 above.

H. H. HAINES.

Record of Notes on Forest Operations.

Replies having been received to the Circular from this Office No. 2, dated 31st January 1895, generally approving of the arrangement sketched in paragraph 4 for the record of notes on forest operations, I have the honour of inviting your co-operation and that of the officers serving under you in the compilation and editing of notes on the lines already indicated.

It has been suggested that the following subjects should be included amongst those enumerated in paragraph 4 of that Circular :—

Injuries done by insects, fungi, etc.,

Rates paid for forest work,

Miscellaneous ;

and to these or any other further additions that circumstances may render desirable, there can be no objection.

A suggestion that each officer should be supplied with a Note Book showing the headings, with a few blank pages after each, does not commend itself to me ; for the reasons that officers will, as a rule, confine their notes to a limited number of subjects, and that an invitation to write on all subjects is likely to lead to the omission to write on any.

Some officers have expressed the opinion that the notes could conveniently be published and discussed in the "Indian Forester"; but there seems to be doubt whether these notes, which relate more to local matters than to specific points or subjects of general interest, would be generally read in a magazine, and I am disposed to think that the publication of such papers as are suitable for discussion in the "Forester" is quite apart from the preparation and printing of notes on local customs and works.—(*Circular No. 1, of Inspector-General of Forests*).

A Tour Through Kishtwar.

At the end of September, 1893, I started on a tour of inspection of the Chenab forests, which I had not yet been able to visit: the route taken was *vid Islamabad to the Marbal Pass*, 11,550 ft. to Kishtwar, then up the Chenab as far as Padar, next turning back over the Punji Pass and on through Boonjwar and Bhadravar into the Ravi valley.

There is no deodar forest up the valley on the Kashmir side, leading to the Marbal Pass and very little other forest till the village of Wylo is passed where a fair extent of inferior pine is met with on the left side of the valley; but its distance from any floating stream depreciates its value at present; this tract contains all the inferior pines but *kail* in small quantities only and some fine walnuts in the lower part of the valley.

The Marbal Pass is a very easy one to surmount, the path leading over grassy slopes on both sides of the range without any rocks; a mule road could be made over it at a comparatively small cost; this would be a great boon to the people of Kishtwar, but to make it of real usefulness two bridges must be built, one over the Maru or Wardwan river and another a mile or so further on over the Chenab just below the Kishtwar plain. I was informed that bridges existed at these two points many years ago, but in the course of time they fell to pieces and have never been rebuilt, their places being taken by *jhulas* which, though the finest of their kind, being broad enough in the footway to carry goats and sheep, are yet useless for the passage of horses or cattle, laden or unladen? this of course is a total obstacle to trade from Kishtwar to Kashmir. It is the more to be deplored as the distance is comparatively short (about 60 miles to Islamabad), and Srinagar is in a direct line from Kishtwar. These two bridges known as Kurai and Bandarkot should be constructed as soon as possible in the interests both of trade and of the people who pay revenue to the State.

After leaving the Marbal Pass proceeding down the Kashar Kol the first deodar forest is met with at some distance before reaching Singhpur. It consists of small scattered patches or

isolated trees, but with closing it is probable that the patches would become joined by process of natural reproduction; these small plots are collectively termed Panj Nali. At Singpur and below on the right bank there is a fair deodar forest about 2 miles long which contains a moderate number of first class trees. On the left bank there are small patches except at Kharni village where there is a small forest of good growth. This valley, which is termed the Kashar Kol, contains three fair-sized streams, the first to the south is the Naidgam (or Degari) Nala, the centre is the Kashar (or Kashmir) Kol and the third to the north the Sinthan Nala.

The Naidgam Nala joins the Kashar Kol at the village of Pasar Kut, while the Sinthan Nala runs into it about two miles below this at the village of Shatru. The former contains very valuable mixed forest, deodar preponderating, extending some 6 or 7 miles from end to end; Sinthan Nala also has a large extent of good forest on the right bank reaching some 6 miles up from the junction at Shatru. On the left bank, below Chingam, there are two separate blocks of fair forest, but the large trees are all to be found on the right bank especially near the village of Dangar where trees of large girth up to 16 feet are to be found. As a rule, the forests on the northern slopes in this tract are of the shady damp type and reproduction is greatly wanting. On the left bank at Dangar village, that is, on south-west slopes, and in the two blocks near Chingam on south and west slopes, the natural reproduction is hopeful, and with fires kept out would increase in a marked degree. Lower down on this bank, above Shatru, there is a large block of forest containing deodar but sparsely stocked. Here there is a small Nala known as Gungnar, which joins the Sinthan Nala below Gilar village. In the forest on this Nala there are a number of sleepers cut by Amir Takar, a mate who was employed by Colonel Bahawalan, but who returned to PUNCH State in 1846. Little work was done here, and it is stated no payments were made to the sawyers. It is said that both Colonel Bahawalan and Gangu Shah of Jammu cut sleepers in the Sinthan Nala, and there are still a number of sleepers said to belong to the latter, lying in the stream.

Formerly work was done in the Kashar Kot and Naidgam valleys, and it would appear that the first to work here was Diwan Arjan, Wazarat of Kishtwar in 1834; he apparently only cut dead trees into logs and these were got out with great difficulty. Next Hira Singh, Agent of Mela Ram of Lahore, felled here, in 1835, under a permit at a fixed rate per tree. He is said to have taken away a lakh of sleepers,—this is the worse kind of permit to give in a forest. The third and last trader to work here was Gangu Shah who began in 1841, and went on under various pretexts till 1848, when he was refused any more extensions. He took out

a great number of sleepers, it is estimated 80,000, and he states he never felled one green tree since his permit was only for dead trees, but as there was no supervision it is impossible to credit this statement. At any rate all private work is now at an end; such sleepers as remain will be brought out by State agency and delivered to the owner at Akhnur. Proceeding down the right bank of this Kashar Kol after leaving Shatru, the next good forest is situated in the two Nalas which join the main stream at Mughal Maidan known as Drabil and Chansiri. There are altogether 5 distinct blocks in the valleys formed by those Nalas, the largest is near the village of Loi. This contains a number of first class trees but the ground is difficult, being precipitous in the upper parts. It is said that Pandit Wasdeo tried sleeper cutting here but gave it up, also that some 400 trees were felled by Hira Singh, Agent of Mela Ram. This forest is of the shady type with much undergrowth and deep ravines; the growth is very mixed and the natural reproduction is bad.

On the left bank below Shatru there is little forest, the grassy slopes being bare of trees till the Sigdi Nala is reached. At the mouth of this there are 3 or 4 small patches of poor deodar forest, but higher, on the west of Sigdi, there is an extensive forest some 3 or 4 miles long which contains fair deodar in the lower elevations. The Kashar Kol valley may be said to end at Saterwadi, for here the stream joins the large Maru River. Between Mughal Maidan and this place there is no forest at the left bank and merely a sparse poor forest at the summit of the range on the right bank.

To sum up there is really good forest still left in the Kashar Kol and since the fellings do not appear to have been heavy it is likely that a detailed examination and enumeration of stock will show that a great many first class trees are available for felling. The forests are mostly very difficult to work, being steep to precipitous, except one or two on south and west slopes in the Dangar Nár. Being of the shady moist type of forest with deep wet ravines, which contain much undergrowth, the state of the natural reproductions is not at all good as a whole. There is not much kail in this valley. Very little damage was observed, the villages are few in the upper part and the people do not appear to indulge in the ruinous practices of barking and torch excavating from living trees to the extent practised in Kashmir. On the whole this may be considered a valley with a very fair extent of forest, containing a good proportion of deodar, while the streams are not too difficult for floating, though the distance to the main river is a drawback. Labour can be had for a moderate quantity of work without much difficulty but extensive operations would require special arrangements for supplies, as the country contains little beyond the local requirements.

Between the junction of the two streams Kashar Kol and

Maru, and Kishtwar, there is no forest whatever on the left bank, and on the right a poor forest of some extent in length but narrow in width stretching from a little below Mughal Maidan to the junction of the Maru and Chandra Bhaga (Chenab) Rivers.

A halt was made at Kishtwar to enquire into certain local cases. While there, the townspeople asked for permission to fell oak trees from the forest above for use in the winter, but after seeing the place and carefully considering the matter I was obliged to refuse, since I could see from what had happened in the past that reckless felling would soon destroy the small forest left near the town. Besides, the lower hill-sides are thickly covered with shrubs of various sorts which can supply their wants and these I said they might cut for the present, but they were distinctly told that, not being zemindars, they had no claim to forest produce free of charge.

Leaving Kishtwar, my route lay up the Chenab which, from Padar till it takes a sudden turn beneath Kishtwar, runs almost directly from east to west, consequently the right bank facing as it does due south is almost entirely barren as regards forest growth, at any rate on the main stream; in fact though there are one or two forests in side valleys, it may be generally said that all the forests lie on the left bank, *i. e.*, on the northern side of the main range which extends in an almost unbroken line from the town of Chamba on the Ravi to Kishtwar on the Chenab.

From the turning point of the range as far as the village of Amné (after leaving Kishtwar) there is a dense forest of broad leaved species only, this reaches from the crest of the ridge down almost to the Chenab below, it contains no deodar and merely a kail here and there. For some distance after leaving Amné towards Bagnai little pine forest is met with till the Nagri Nala is reached, were above Kowar village is a good deodar forest on steep ground. *This extends as far as Bagnai, a distance of some five miles.* Mela Ram is said to have felled for sleepers in the Hindi year 1935. Opposite Kowar on the right bank of the Chenab is the village of Sergi and near it the one forest on the right bank so far; it appears to contain little deodar and from its situation to be of small value. Sergi is a Jagir formerly held by Wazir Bandju who died on the 12th October, 1893, while I was on the present tour.

The forest between Kowar and Bagnai is not of one type, in parts deodar preponderates, while on the Negam Nala a fairly big but rocky stream next to the Nagri Nala (up stream), there is a larger admixture of oak and other broad leaved species, and near Bagnai itself there is a great deal of kail (P. E). Just below Bagnai a large stream, called locally *Changun Nala*, is crossed, this contains extensive mixed forest on both banks for two or three miles, but the stock is mostly of inferior pines and broad leaved species, except for two moderate plots which contain some deodar, one on each side of the

valley. From the Changud Nala there is a continuous belt of forest containing deodar, extending as far as Korní village. One part known as Kontinnar was worked to a small extent by Colonel Bahawalan; beyond this is Changuara village and above it the forest as regards deodar, is of a better class; there being a good number of first class trees, this plot is as usual generally a mixed forest but some parts are almost pure.

Opposite this across the Chenab is a village called Chicha, which has lately been abandoned by its inhabitants. Above this is a poor deodar forest, but one which will improve with time; a little higher up are three or four small patches of deodar on precipitous ground.

There is a break in the belt of forest at Karní village, otherwise it would be continuous from Bagnai right up the valley to Padar. It is not of one character; thus in some places there will be found all the conifers—deodar, kail, tos, rai and chilgoza all together on one hill-side, together with broad leaved species including even ash; while in places kail preponderates and in others, generally the lower parts towards the river, there are more broad leaved kinds than conifers. After Bagnai almost up to Padar the country is very rugged and steep, in some places huge blocks of stone lie piled one over another as big as a house with enormous oak trees growing in among them; then a corner is turned and a steep grassy slope is reached without a tree of any kind. In such a country, far from civilisation, roads can hardly be expected and the path leading from Bagnai, nearly as far as Padar, is a mere goat track and goes down to the bottom of a valley only to ascend straight up the other side and thus it continues for several marches; altogether this is a most difficult country to carry on work in, since in addition to natural obstacles, there are very few villages, and of the few several have been lately abandoned owing to various causes and the land lately cultivated is fast lapsing into jungle.

It would appear that very little felling has taken place in this part. I made enquiries, but could only hear of certain work by Gangu Shah at a place known as Nonatu, beyond Piás a deserted village; and that Sirdár Suján Singh had felled in a forest called Solo between Kidru and Tatwání. On the opposite side of the river there is some sparse deodar forest on bad ground, and just in front of Tatwání is an oak forest, but on the whole there is very little forest worth anything on the right bank from Padar right down to Kishtwár.

The Kishtwár Tahsil ends at Atoli where the Bhutna, a large stream joins the Chandra Bhága; across the river from here is the Padar Tahsil on the Bhutna river. Above Gulábgarh and on the left bank there are 9 or 10 small plots of deodar which are worth conserving as they lie just over the river.

There is also more deodar forest higher up the Chandra

Bhága towards the Sansari river, which forms the boundary between the Kashmir and Chamba States, but as it was late in the season I could not spare the time to visit this part during the present tour.

It is therefore certain that the State possesses valuable deodar and other conifer forests on the Chandra Bhága and on the Kashar (or Kashmir) Kol, but owing to their constitution, that of having not only pines but a large proportion of broad leaved species such as oak, ash (in a less degree) maple, horse chestnut, &c., they will require far more delicate handling than the type of forest found in Kashmir; since, unless the greatest care is taken in carrying out fellings, there will be the danger of other species, even the broad leaved, taking the place of the deodar. For the present, therefore, until trained officers are available who shall carry out demarcation and ascertain the capability of the forest as to yield, the work should consist solely in clearing the Nalás of stranded logs whether by launching, where possible, or cutting into sleepers, utilizing the dead and fallen trees, and finally cutting out dying and badly shaped trees. When these sources fail we shall probably be ready for systematic fellings, but on no account should more be done till then, however tempting the market rates may be and still less should the old and pernicious system of permit felling be returned to.

From Tatwáni village at the extreme end of Kishtwár my route now lay up the Bángar Nála to the Punjdhár or Pass which according to the map, leads into Boonjwár, but after a most arduous ascent and descent over the Pass which must be 15,000 above sea level, I found myself in the Sharoti or Koli stream in Sooroor Iláka. There is little forest in the upper part of the valley and very little deodar at all. At Goro village there are two forests containing deodar, but of small extent, they however contain some fine trees, two measured 18 and 14 feet girth and were standing close together. It is said that some 10 years ago Sant Singh of Amritsar cut some trees below this in a place called Churusu, about 300 or 400 trees.

From this valley I crossed the range into the Boonjwáh valley to enquire into some fellings reported to be going on in a State forest. Joalpur is the principal village in Boonjwáh, and the Tahsildár of the *jágir* (the late Wazír Sheb Saran's) lives at this place. There is little forest on the right side of the Kailnái stream which drains the valley, the only pieces being two small deodar forests on the spur above Joalpur and one fair patch of oak forest above them. The great forest in this *jágir* is on the left bank just opposite Joalpur, it extends from the village of Dichal, down stream, for a distance of some six miles upwards, the western part has many blank spaces and much broad leaved growth; the best part is between the Alni and Kinsnái ravines, but all the mature trees are being rapidly cut out. From its position on the

northern side of the range which naturally marks off the Bhadravár *jágir*, it is clear that this forest is part of the Boonjwáh *jágir* and as such would appear to be a State forest, since the *jágirdár* has no right over the forests; but the Agents of the Bhadravár *jágir* have been and are cutting many thousands of sleepers yearly; the matter has been referred for settlement, as in such important matters there should be no room for doubt.

For the next three days the route lay through the Bhadravár *jágir* *via* Charao and Jaora to Bhadravár town. As this is private territory it need only be said that there is still fine forest left in Basnota on the Kar Nála with a good proportion of deodar in the lower portions; also a long narrow strip on the ridge above Zunglewár; a good extent in the next valley to the south known as Badota, some good patches at Chinta nearly pure, and some nice plots of good extent at the head of the valley above Bhadravár town towards the Chattardhár Pass, but from want of proper conservation these forests are fast deteriorating.

My route lay over the Chattardhár Pass into the Sarthal or Jabbar Nála draining into Siáwa river which forms the boundary between Chamba and Kashmír territories.

Near the head of the Pass (10,100 ft.) there is a good deal of oak forest gradually passing into spruce and silver fir as the valley is descended; on the right bank it is continuous for 5 or 6 miles but not of a good class, reproduction being very poor. On the left bank above Sarthal village there are 5 or 6 small plots of nearly pure deodar none over 200 acres or so in extent, but these contain some excellent young growth. Fellings went on here years ago under the late Mehta Kashu and he appears to have felled every mature tree, even to those on the ridges which should have been left for seed. Between Sarthal and Chunchli there are a few small scattered plots of deodar on steep ground, but here also everything of any size has been felled, the hill sides being now dotted with white stumps; on some ridges not a tree remains large or small. Below Chunchli there are a few small plots of deodar on both sides of the river, and in the Kinsun Nála, which joins the Sarthal at Chunchli (though it is not shown on the map), there is a large extent of mixed forest which will require a detailed examination. Extraction is still going on here, a number of sleepers are now being brought out by Cheta Rám who has brought trees from Ganesha Mall, who in turn bought 700 trees in Sawan 1,943 from the then Basoli *jágir*. It is very unsatisfactory, so long after the *jágir* was resumed by the State, that traders should still be working in the forests, but nothing can be done till these sleepers are cleared out; the fear is that by collusion with the establishment the traders may go on felling trees and in the present weak state of the Department, this will be most difficult to prevent. Above the village of Banni there is a fair deodar forest but almost entirely worked out.

From here I turned off to the east up the Sandrun Nala. Above Aso there is a nice little deodar forest almost pure, with very fair reproduction. The Sandrun valley in its upper parts is very well wooded, but the forest is very mixed and does not contain much deodar. Here also the usual destructive fellings went on when it was *jāgr* property and there is little left to cut.

To show the ruthless way these traders worked it may be mentioned that on the Siāwa valley there is only one small forest in the Bandar Klāka, this contains a *deota* and is considered to be sacred by the villagers. They informed me that the traders felled every large tree in it during 1886; they say they protested but were told it was the order and after all merely 40 trees were obtained altogether.

From here my tour ended, and I proceeded *viā* Dalhousie and Lahore back to Srinagar, the season being too far advanced for any more work in this part.

From what I saw of this part of the Rāvi and from many enquiries made, it is quite evident that the Rāvi forests have been completely worked out in the period during which they formed the Basoli *jāgr*, and nothing now remains but to shut them up absolutely until they have been demarcated and carefully inspected in detail; when a trained officer is available for this division, it may be possible to undertake small fellings of dead and dying trees sufficient to cover the cost of their up-keep but on no account should anything be done till then and never should a trader be allowed again to put foot into this region. The forests of the Sarthal valley are generally on dry ground and as is usual the natural reproduction is much better than in those of the humid type on the Chenāb, and there is no doubt that after a long period of closing and careful management, they will again become of great value to the State. In conclusion I may say that it is absolutely useless to try and manage these Chenāb and Rāvi forests without a large increase of establishment and without a trained officer over each division. Lying as they do at a great distance from head quarters it is quite impossible for the Conservator to give them as much attention as can be given to those nearer home, and therefore the subordinate establishment must be stronger and of a better class than that in more accessible regions.

(Sd) J. C. McDONELL,

Conservator of Forests.

A Fire-resisting Tree.

An interesting account of a fire-resisting tree is given by Mr. Robt. Thomson in a consular report on Columbia. He writes : the thousands of square miles of natural pasturage on the plains and lower hills of Tolima assume during the rainy season the most beautiful verdure. But in the alternate season of drought the general aspect is that of a desert. These lands were originally acquired at a nominal cost. No conservation of the natural fertility of the land has ever been taken into consideration. On the contrary, the natural grasses, intermixed with scrub or brush wood,

have been systematically burned from year to year and the burnings effected during the most scorching periods of drought. The principal object attained by this process of despoliation is the reproduction of new and tender herbage or pasturage, which, with the advent of the rainy season, forthwith covers the parched surface. Vast pastoral regions scores of thousands of square miles, in tropical America, are thus maintained. Half a century, or it may be a century, of this treatment suffices to extinguish almost every trace of fertility in the soil. In Tolima alone hardly less than 2,000 square miles of savannahs and hills, ascending to some 3,000 feet, have in this way been transformed into comparatively barren wastes. And in other parts of the Republic many thousands of square miles have similarly lapsed by this devastating process.

This persistent burning of the savannahs and hills for crops of renewed pasturage plays desperate havoc with all other vegetation, trees, and brushwood. Isolated palm trees, with their intensely hard trunks and endogenous structure, together with groups of brushwood in sheltered or humid spots, sometimes withstand the fury of the flames. There is however one phenomenal exception to this subversive power of the fires. A humble tree with contorted and rugged trunks and branches and scabrous leaves, a tree presenting the most subdued and weird aspect conceivable; this pigmy tree not only resists the fury of the flames, but fire is actually congenial and subservient to its existence, for the tree, instigated by the conflagrations, forms itself into great plantations. The name of this tree is Chaparro (*Rhopala obovata*), indigenous in Colombia and South American countries. It attains a height of from 15 to 20 feet, and its distorted trunks measure from 9 to 12 inches in diameter. It is widely distributed in Colombia, for I have found it at the Sierra Nevada of Santa Marta and dispersed inland 1,000 miles from the sea. In contact with great forest fires it maintains a precarious existence. But, as already explained, it usurps dominion in places where no other tree can grow. In Tolima it abounds on the slopes and ridges of the hills at elevations from 1,000 to 3,500 feet. In this department alone hundreds of square miles of the lower hills which have been reduced to sterility by incessant burning are occupied by this diminutive tree, and it assumes the aspect of vast systematically formed and well-kept plantations. This is more than a triumph of the "survival of the fittest." It is very remarkable that these fire-begotten plantations are nowhere crowded to excess; on the contrary the trees are so regularly placed that their aspect vies with that of the most carefully formed plantations. There is a popular belief in Tolima, where alluvial gold abounds that this tree flourishes only on those seductive lands, serving as a guide to searchers after the precious metal.—(*The Forester—New Jersey, January 1896.*)

Camphor Leaf Oil.

The recent high price of camphor, on account of the war between China and Japan and trade monopolies, has caused some anxiety in countries where it is largely consumed, and China and Japan being at present the only two countries where camphor is produced on a large scale, it has been thought desirable that its cultivation should be taken up in other lands. In Japan the camphor trees grow at high elevations away from the sea and only large trees of about one hundred years old are selected for use in making the camphor. From the export returns of this country, it seems that the supply is gradually becoming exhausted. In the island of Formosa the camphor trees are said to be by no means plentiful, and they grow only in certain favourable situations, as far as the climate is concerned, with savage tribes in the immediate vicinity. Here the trees are not considered worth taking until they are fifty years old, and the wood only of the roots and stems is subjected to distillation.

The camphor tree grows very well in India. The Calcutta Botanic Gardens possess a fine avenue of trees, which were introduced in 1802. It grows well in the Ootacamund Botanical Gardens and in other parts of the Nilgiris. It has been planted, as an experimental measure, at Jhansi in the North Western Provinces, and in other districts in the plains. Camphor has been known and used in India for many centuries. In A. D. 642, Indian princes sent camphor as a tribute or offering to the Chinese emperors. At one time the tree flourished in Nepal and Tipperah, a large tract of land lying between Bengal and the Upper Irrawaddy. Within the present century camphor was imported from Chittagong, but it has been said that the discovery of the hill-men of distilling it from the root led to the extinction of the trees.

In Ceylon, the camphor tree grows well at elevations of 5,000 feet and less; it has the habit of a willow in the island, and it has been suggested that, like a willow, the trees should be coppiced, and the leaves and branches used for preparing the oil. The tree grows for ornamental purposes in Naples and other parts of Italy. Professor Maisch in 1891 reported on the cultivation of camphor in Florida, where it flourished in almost any soil. The solid oil was made from the leaves and branches; the yield was 4 per cent., and the product was more like that of Japan, as it had an odour of safrol. California has lately become the scene of an industry which has for its object the planting of the laurel camphor and the preparation of the oil for the American market. The tree has also become naturalised in Java, Brazil, Jamaica and other isles of the West Indies, Mauritius, and Madeira.

It is very evident that the camphor tree is able to grow very luxuriantly and extensively in the warmer temperate and tropical parts of the world, far removed from China and Japan, but the slow

growth of the tree would prevent all but large capitalists from opening up plantations and waiting for the plants to sufficiently mature. If it is true that in the island of Formosa the wood only of the larger trees is used, and the leaves and branches rejected, then there can hardly be a scarcity of the trees, or the manufacture must be conducted in a very reckless and extravagant manner. The camphor from the *Dryobalanops* tree is said to be quite liquid if a young tree is tapped, and solid if it is old. Under such circumstances it would seem that the liquid oil constituted the first stage in the development of the solid substance. It is stated in some textbooks on *Materia Medica* that the stearopten exists in every part of the plant, including the leaves. On the other hand, it is remarkable that the leaves are not used in China and Japan; perhaps the natives have found that the leaves only give a liquid product which cannot be profitably turned into camphor. As there is no definite information on the point to be found in any description of the industry, I thought it would be interesting to try the effect of distilling the leaves. Another reason that encouraged me to make some experiments in this direction was the hearty manner in which some energetic planters of Ceylon have taken up the camphor question.

A large number of experiments have been made and a great deal has been written, with regard to camphor oil, the bye-product obtained in refining crude camphor before it is formed into blocks. This has been proved to be a very variable liquid with a specific gravity ranging from 0.88 to 1.00, an erratic optical rotation, although usually to the right, and containing camphor in suspension, or in solution, or none at all.

The first sample of leaves came from an umbrageous tree growing in the Government Gardens at Ootacamund. Fifty pounds of the leaves in a fresh state were distilled in a large copper still with sufficient water for six hours. Eight fluid ounces of oil were separated from the distillate, giving the yield of essential oil one per cent. The oil had a slightly yellow colour, a specific gravity at 50° C. of 0.9322, and a rotation of +9°.4 in a 2 decimetre tube. It gave off a small quantity of liquid at 160°, and began to boil regularly at 175°.

Collected below 180°	=	20.6
185°	=	31.0
190°	=	15.5
195°	=	10.6
200°	=	5.6
205°	=	3.3
Residue	=	8.6

95.2

The loss here was occasioned by some of the camphor congealing in the condenser; the amount, however, in this sample

could only be about 10 or 15 per cent. The residue in the retort was quite solid in the cold, and had a yellowish colour and strong camphoraceous odour.

The second sample was obtained from some younger trees grown at Naduvatam on the Nilgiris, a district more than a thousand feet lower than Ootacamund. The leaves were distilled in the same manner as in the previous experiment, but a large quantity of camphor condensed during the process and almost choked up the worm of the still. About four ounces of liquid were collected, having a mass of crystalline matter suspended in it. The oil was strained through cloth, and the solid matter, pressed hard to remove all the liquid portion, was left as a cake of camphor, weighing two ounces. The clear oil had a specific gravity of 0.9314 at 15°C., and twisted a ray of polarised light + 54° in a 2 decimetre tube. It began to boil regularly at 165°.

Collected below 185°	=	13.3
190°	=	20.0
195°	=	15.5
200°	=	20.0
Residue	=	25.0

93.8

The loss was again accounted for by some of the camphor condensing in the cool tube. About one-half of this oil consisted of solid camphor, or, calculating the camphor already separated, the oil from the Naduvatam leaves contained 75 per cent., which is a very satisfactory result. The camphor dissolved in rectified spirit, twisted a ray of light \times 30°. The altitude of the Government Gardens in Ootacamund is 7,300 feet, and it is possible that this elevation influences the formation of the solid stearopten in the leaves. At any rate, it is interesting to know that a large proportion of camphor can be obtained from the oil of the leaves and from the leaves themselves, and probably, if taken from trees grown at a much lower elevation, a much larger proportion of this useful substance could be collected. (David Hooper, F. C. S., in the *Pharmaceutical Journal*, *January* 1896.)

Fig. 1

1st Stage.

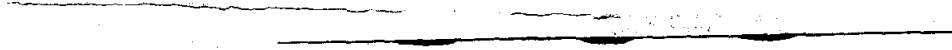


Fig. 2

2nd Stage.

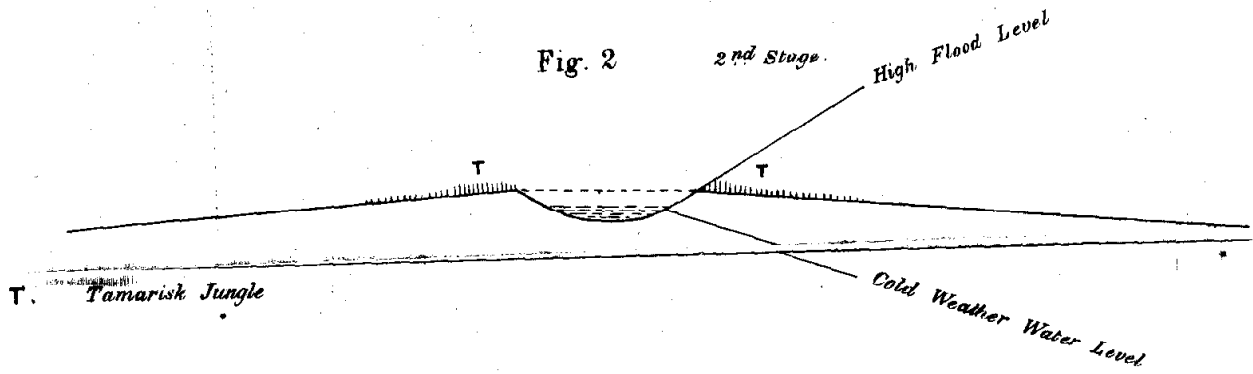


Fig. 3

3rd Stage.

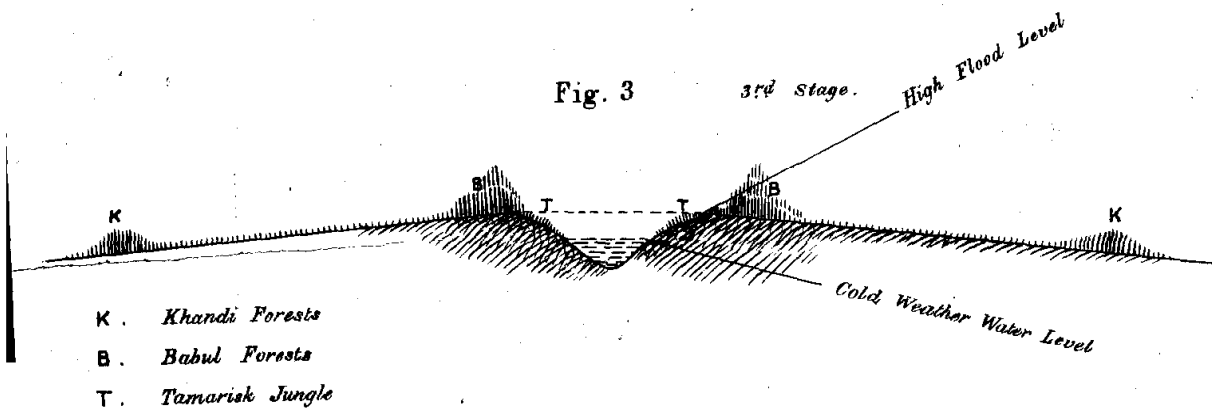
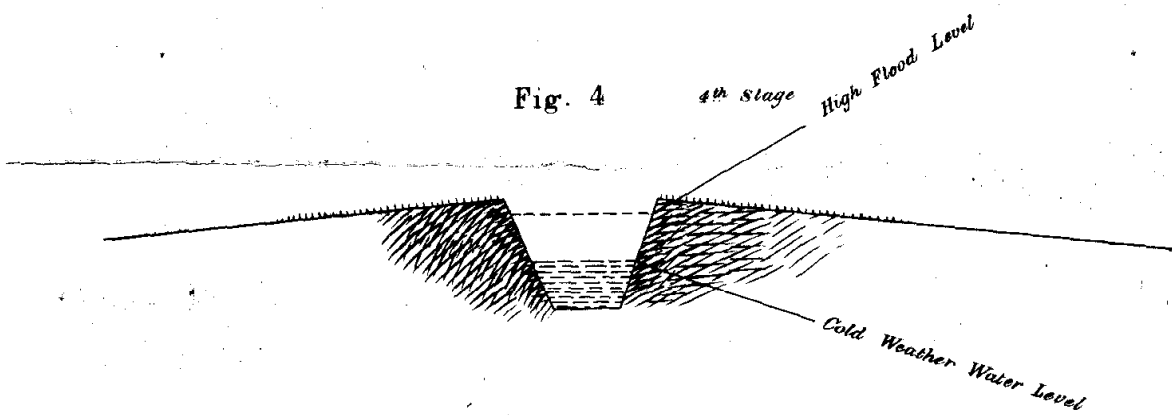


Fig. 4

4th stage



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The River Indus and the best method of embanking it.

The formation of the alluvial tracts of Sind and the Punjab are due entirely to fluvial deposits which the Indus and its tributaries have brought down in solution. Such deposits continue during many centuries, and their progress is so gradual and slow, that results are never, if ever, visible in the life-time of individuals: it is only by a reference to history or geology that the changes which have taken place in certain localities of the globe by the mechanical action of rivers can be observed.

As an instance of the comparative rapidity and extent of such deposits, it is interesting to mention that about 20 miles of alluvial land has been added to the mainland of Italy since the time of Augustus by deposits from the river Po, for the town of Adria which formerly stood on the coast and which gave its name to the gulf, now stands about that distance inland—similarly the Rhone which enters the Lake of Geneva, a rough muddy stream, passes out a clear transparent blue having deposited its sediment in the lake. The small Roman town of Portus Valesia (now called Valais) which as history records stood on the margin of the lake, is now nearly two miles inland, the river having added to its delta this tract of alluvial land during eight centuries; and in course of time in this manner the whole lake will be filled up. It is even so with Sind; the present tract of alluvial country extending from the Bhangar lands in the Punjab to Ketty Bunder at the mouth of the Indus, has all been reclaimed from the sea by deposits from the river Indus and the process of reclamation is still going on. If the Rhone and the Po can show such marked changes in so comparatively short a space of time, what must be the action of the Indus whose deposits probably are equal in amount to those of the Ganges, regarding which it has been calculated that at 500 miles from its mouth it carries 577 cubic feet of solid matter a second, its annual discharge being equal in weight to the 60 great pyramids of Egypt and so great in bulk that if accumulated upon Ireland it would raise the surface of the whole island one foot in 144 years.

The delta proper of the Indus which now commences about 25 to 30 miles below Tatta was not very distant from that town probably when young Cook was buried there 151 years ago. Old geographies even now have it that Tatta stands near the coast, and this indicates how recently it must have been almost a seaport and how very rapid comparatively are the changes that are now taking place. Tatta is now about 60 or 70 miles from the Indian Ocean and the influence of the tide is no longer felt there. Its ebb and flow are noticeable a little below Kotri Allahrakis where the bifurcation of the main channel takes place and where the delta proper commences. The above details are merely mentioned to show that there are extensive agencies at work in Sind : that the river as it emerges into the sea by its various mouths is gradually filling them up and pushing tongues of alluvial land as it were out into the Indian Ocean.

An inspection of the coast line of Sind would disclose the fact that the ocean for some miles out is tinted with particles of sediment which the river has ejected and which are gradually sinking to the bottom. This repeated deposition of sediment causes the sea along the coast to become shallower and shallower, until at length a mud flat appears above the surface level of the ocean at low water. As a survey of the coast line is being carried out, the new maps prepared by the Survey Officers will supply interesting evidence of the extent of land added in this manner to the peninsula during recent times.

By a process slow and gradual as above described are peninsulas formed ; such as that of Italy already referred to, and that of Florida, and in such a manner, it is repeated, have the alluvial tracts of Sind been acquired from the sea.

The manner in which the Indus performs this task of reclamation and the mode in which land is gradually elevated out of the water subsequently above the river floods, are subjects of geological study, and may seem out of place for description here ; but the circumstances attending the formation and elevation of alluvial land and the effect which such elevation has on the action of the river, have an important bearing on the engineering works undertaken within tolerably recent years in the Province ; and if the various phases through which the stream passes before forming peninsulas be carefully observed, it will be possible to form a fairly accurate estimate of what sort of treatment to give the river in the matter of embanking. No accusation of ignorance regarding the subject on the part of Engineers is insinuated in the foregoing remarks, for there is a distinct conflict of opinion it is known, as to the causes which lead to the action of certain rivers, notably the Po, among scientific men, but the conclusions arrived at here are conclusions drawn from a study of the river *per se* during several years' residence in the Province and of time spent chiefly along both its banks, and it will be interesting probably to record them.

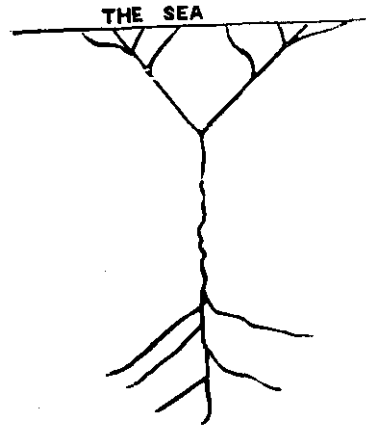
The construction of a delta depends very much upon the position of a river's mouth. The river water charged with sedimentary matter is swept out to sea and there deposited ultimately to form stratified rock. A little reflection would show that supposing the river to be carrying sand and clay in suspension, the sand being heavier would be deposited first and the clay further down near the mouth and lighter particles of clay would be swept out to sea, there to be eventually deposited. If the mouth of the river be swept by an ocean current, some of the particles of clay would be carried out and tint the ocean around (as can be seen in the case of the Indus in the journey from Karachi to Bombay in a coasting steamer) and a counter-current would probably return some of the sediment to the shore at another point before it had time to sink to the bottom. In this way, sedimentary matter might be held in suspension some time and be carried some distance before it finally settled at the bed of the ocean. The Indian Ocean being swept by currents, the constant silting up of Karachi Harbour, for instance, can to a certain extent be accounted for where extensive dredgings to clear a channel for vessels to enter is resorted to. A large part of the lighter sediment, however, which is brought down by the river is deposited at its mouth and along the coast, until in time the sediment or mud flat appears above the surface level of the sea at low water. The mud-flat thus formed becomes intersected with numerous small channels, as the tide which is felt all along the coast, and which runs five miles an hour up stream near Ketty Bunder, recedes. The small channels formed at first by the ebb of the tide would not be obliterated by the subsequent incoming one but deepened, and when the flat became elevated sufficiently above the tidal waters, the irregularities would remain eventually to form water-courses or creeks, and such a net-work of channels may now be seen near and below Ketty Bunder along the coast. The present condition of the lands immediately on the sea board may be taken therefore as the first stage of the delta, showing the manner in which the river ramifies into numerous small channels on meeting the sea.

By this ramification over the flat ground, the velocity of the current of the river is gradually diminished, and the deposit of sediment facilitated, consequently the small channels formed at first are in time filled up, while new ones are cut through the soft alluvial soil * by the river flowing down. The second stage of the delta then is where those constant shiftings of the channels have so elevated the country generally, that instead of a net-work of streams, two or three main arteries would remain forming a triangular island approaching to the shape of the Greek letter Δ delta.

* *Vide* Professor Geikie in his work on Geology.

The process of elevation of this delta would, as may be imagined, continue, as the area in the flood season became subjected to lateral overflows from the channels of the river, and with each overflow would be added a fresh deposit of silt, until the whole deltaic area eventually was so elevated that water flowing in the river instead of ramifying into two or three channels would run into one, the slope of the land by its elevation having caused a swifter velocity in the current of the stream. The stage at which the lands through which the river passed will have entered when this occurred, would be the third, and the country from near Kotri-Allahrakis upwards to Bahawalpur may be said to be an example of it.

But a fourth and final stage of the country yet remains, and that is where the single channel formed by the river *ceases* to overflow its banks, and this condition of things is observable in the case of the Bhangar lands in the Punjab, which are all of alluvial origin, and which are now out of the reach of the highest floods. Undisputed geological evidence exists, however, that they must at one period have been subject to lateral overflow exactly as the lands in Sind now are. The development of the delta in this manner is an interesting geological fact borne out by observation and experience, and it is also interesting in so far as it causes the course of the river to resemble in form, when illustrated on paper, the growth of a tree. Taking the main source of the river as the tap root, we have rootlets, and a stem being thrown out with branches, which in turn ramify at the crown as follows :—



The tendency of an inundation river traversing a flat alluvial plain which reaches the sea by two or more channels if left to itself, would appear to be to form a *single channel*, and although the banks be of soft consistency, to confine themselves ultimately within that channel and not overflow them even in the flood

season, and this is a conclusion which no one after carefully examining the subject will deny. Professor Geikie in his work on Geology, in referring to the mechanical action of rivers, says: "The 'most solid rocks are worn down; deep long gorges are dug out, and the water courses when they have *once* chosen their sites, remain on them and sink gradually deeper and deeper beneath the 'general level of the country."

Commencing then with the Bhangar lands it is interesting to trace briefly the various stages through which the river must have passed, and ascertain the manner in which it has reached its present condition there.

1st Stage.—

Supposing the delta of the Indus to have formerly stood where the Bhangar lands of the Punjab now are, *i.e.*, presuming the area covered by the alluvial plains of Sind to have been a sea as extensive almost as the Persian Gulf, the manner in which this sheet of water was gradually filled up, will not be difficult to understand after what has been explained.

Immediately near the mouths of the river the deposits or mud-flats in course of formation would, as before explained, be almost entirely of pure clay, and so unsubstantial as to contain the lowest order of vegetation, such as the mangrove. The area would be subject to tidal overflows and be intersected by creeks, and parts higher up being in a slightly more advanced stage, would probably be fit for pasture and rice cultivation. This corresponds with the present condition of the country in the vicinity of Ketty Bunder which now grows grasses and a coarse red quality of rice flourishing from fresh and salt water spills.

2nd Stage.—

As the tongue of alluvial land was driven further out, a little sand would commence to be admixed with the clayey deposit (tidal overflows will have ceased) and the two deposits combined would form a loam capable of bearing a higher order of vegetation, such as Tamarisk which would flourish mainly by fluvial overflows. An inspection of the country as it now exists some miles south of Kotri Allahrakis where the bifurcation of the main channel commences will shew this to be the case.

3rd Stage.—

The onward march of the delta still further out to sea would naturally increase the amount of sandy deposit in what was originally the first stage of the river, for it must be remembered the mouth of the river proper would be now about 80 to 100 miles away, and with the addition of vegetable mould and drift, the soil would become richer and capable of bearing a higher order of vegetation, such as Babul (*Acacia arabica*) and the latter would begin to dominate the banks as is apparent in Sind. As the soil became richer by repeated overflows, in the inundation to which of course it would still be subjected, and grass and trees grew up and increased, the roots of the trees will have commenced to form

a fibrous net-work under ground, the dense grass and other vegetation will have obstructed the outgoing and ingoing of water, and catching more of the sediment, will have gradually formed as it were spoil banks. The flow of water would then be diverted towards the centre of the channel; the overflows would gradually become less heavy and irregular, and in this way by a slow but steady process a scour would set in.

4th Stage.—

But beyond the river and forests of Babul further inland, would be found another class of forest, *i.e.*, Khandi (*Prosopis spicigera*) which would be maintained not by annual inundations but by floods once every eight or ten years—such watery visitations would occur during the third stage of the river and would just keep the Khandi forests alive. Each succeeding flood, though rarer, would heighten the natural spoil banks, until eventually they would be so heightened and become so cohesive and firm, that overflows and erosion would entirely cease. The spills having ceased, the Khandi which is a deep-rooted plant, would have marched up as it were to the margin of the stream to gain sub-soil moisture and to replace the Babul, which being a shallow rooted tree, would now have died out from want of it. When this took place, the fourth stage of the river, *i.e.*, the elevation of the natural flood plain will have been entered (wherever Khandi flourished gregariously near the river bank before the advent of bunds, the overflows were known to be rare). There being no overflows at all eventually and the tendency of the river now being to cut its way down deeper and deeper, the Khandi forests could not endure everlastingly, for subsoil moisture by percolation would not reach the roots and with the browsing of goats and camels, to which the trees would be subjected to above, they would also begin to die out, until at length no natural forests would fringe the banks, and this is the condition of the Bhangar lands which are high above the highest flood level of the river. By such a slow and gradual process extending over many centuries perhaps have the Bhangar lands arrived at their present high and dry stage, and if this is not the only explanation of their origin, surely there is no other. It would appear then that the river after having quitted the second stage of its existence, chose its channel as briefly shewn and proceeded to excavate it, and this process of excavation will continue still further till in after ages alluvial terraces will be left that will mark successive flood levels where the river has at one time or other flowed.

Ketty Bunder, a tolerably large and flourishing town in the delta proper (first stage) now containing several masonry buildings is on one arm of the river, which it is not improbable will be forsaken before very long in the manner here shown and similarly as the arms on which Shah Bunder and Ghorabari once stood. This is doubtless the cause which finds Brahminabad being

situated so far away from the present course of the river inland, when it is more than probable that at one period it must have stood on one of the arms of the Indus in the delta.

The period when this town flourished is not accurately known, but its greatness probably is coincident with the time when Babylon was at the zenith of its fame (565 B.C.). A very extensive trade with India was carried on along the Euphrates during the existence of the Babylonian Empire, and it is probable that Brahminabad being then an important seaport of India, exchanged its wares for those brought from the Persian Gulf. Between the port of Gharra half way up the gulf on the Arabian coast, and India at this time (565 B.C.) there was, as history records, an active maritime commerce carried on by Phoenician colonists, and Brahminabad possibly was the Indian port at which the Phoenicians touched. If this presumption be correct, the extent of alluvial land added to the Province during 2,400 years can be seen at a glance from the map. That Brahminabad was formerly a large and flourishing town as Sukkur or Kotri now is on the only channel of the river then existing, and this channel suddenly was deserted, is a theory which does not agree with the principle upon which an inundation river acts. The old forsaken beds of the river now observable meandering all about Sind from Bahawalpur downwards, are nothing more than the remnants of former old arms of the river, which have now been permanently deserted and which would exist in *its delta* stage[†] and which in time would be forsaken, as the latter, was thrown further and further out.

As almost every part of the alluvial plains of Sind must have at some time or other formed part of the Indus delta, the forsaken beds of the river would be visible everywhere especially in places where time and floods have not had an opportunity to obliterate them. In the Punjab, for instance, all signs of such old beds will long have been obliterated, but in Sind, as explained, which is comparatively of recent formation, such signs would still be visible. The protective works undertaken during the past 30 or 35 years in the Province, moreover, have assisted to obstruct the complete obliteration of such channels in places, but a great number can still be traced.

During the second stage* the forests fringing the river are mostly of Tamarisk, and the country in the inundation season, for the most part where there are no bunds, is impassable, because of the river floods which sweep over it.

A little Babul also here and there may be seen growing gregariously inland at this stage but it is mostly stunted and immature. The river during this stage, is split into two or three channels, it must be remembered, so that one channel out of the two, perhaps, in a season is not so flooded as the others. Sometimes in one arm of the Indus scarcely any spill takes place in the flood season, the greater volume of water having gone down elsewhere.

† See plan, fig. 1.

* See plan, fig. 2.

In the third stage* the Babul, according to the theory of the survival of the fittest, has supplanted the Tamarisk on the bank proper, and the latter now can only be seen just fringing the inner toe of the slope of the natural embankment. Further inland may be seen the Khandi which is only reached by the river water in seasons of abnormal floods, but being a deep-rooted plant, entering 50 to 60 feet into the subsoil, it retains its vitality by subsoil percolation mainly from the river.

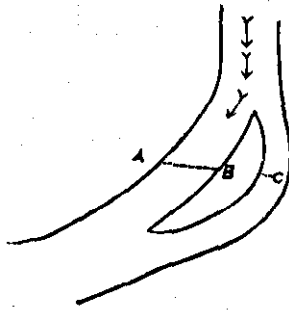
In the fourth stage† the river banks have no forest trees. Even in the flood season the waters do not spill over this country, and hence artificial irrigation only is resorted to. The is exactly as in the Bhangar lands. Canals, however, take off from the river here to irrigate inland tracts, because as can be gathered the land slopes inland from the river.

As the third stage of the river developed, the spills over the banks would get slighter and slighter, and if old reports be alluded to, it will be seen that such was beginning to be the case in parts of the Province, showing that portions of Sind had gradually commenced to approach the end of the third stage. In Dr. Schlich's Annual Administration Report for Sind for 1870, when practically no bund system existed, he refers to the difficulty of irrigating some of the Babul forests on the river bank, except by artificial means owing to the absence of annual spills. Any old resident, however, could confirm the statement that the overflows in the Babul region before the bunds were introduced had diminished, whereas they undoubtedly have become heavier, and what is more, in places where for 25 to 30 years no overflow occurred at all, almost annual heavy spills now take place. Observation and experience clearly show in fact that the river after almost completing the elevation of its flood plain, especially in Upper Sind, had before the advent of bunds arrived at a stage when its work of excavation had commenced; that its habit of leaving islands and making tortuous windings and bends thereby causing destructive erosion as in the delta now, had to a very great extent commenced to cease and that the lands on either side had begun to be permanent and the spills to be slight. A reference to very old maps (of 200 or 300 years ago) if they existed, showing the course of the river above Kotri, would probably depict side channels of the river existing, which one by one were deserted as the development of the stage of the river increased. The distance between the extreme left bank of a side channel and the right bank of the stream proper indicated its original natural section. An abnormally heavy deposit of silt and some obstruction of drift had perhaps collected in the channel in its early stages, and instead of being

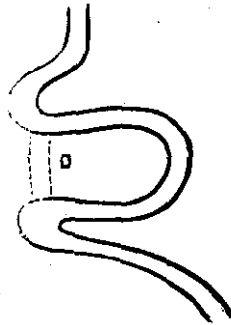
* See plan, fig. 3.

† See plan, fig. 4.

swept away, increased in size, and so split the stream into two parts *pro tempore* as below.



This side channel (C) gradually filled up as the development of the river stage increased, and the distance between A and B eventually formed the remaining main section of the stream. Where considerable tortuous windings existed during the second stage, and a small strip of land intervened between the two encroaching branches of the river, a cut off (D) would occur as follows :—



This left at the side a crescent-shaped lagoon or 'dhund,' and in this manner nearly all the curves and bends commenced to be shaped off as it were, and the section of the stream to be tolerably straightened and narrowed. A study of the river now would show that this process of development which old residents could corroborate no longer continues ; that the waters instead of narrowing and deepening their channel, are taking a more sinuous course and widening their section—carrying away, *i.e.*, eroding what had come to be considered *permanent* land, and leaving more sand banks or *kachas* visible in the cold weather, which fact is corroborated by the Conservator and Registrar, River Indus, who has

stated that the river navigation is far more difficult than it used to be owing to its shallowness, and owing to the increase in the number of shoals in it, and confirms the oft repeated complaints made in Sind Forest Administration Reports of good Babul forests being washed away, and useless mud and sand banks being left in their place instead. The Indus Flotilla steamers, 30 or 35 years ago, used to travel up and down stream between Kotri and Sukkur and beyond, heavily laden with troops and stores of all descriptions, with apparent facility, but now the Commissioner's steamer "Jhelum" finds it difficult to move along in the river in the cold weather. Quite recently, in fact during H. E. Lord Sandhurst's tour in Sind, the S. S. "Outram" on which he was travelling, stuck on a shoal and delayed him for 24 hours.

There seems to be but one reason for all this, and that is the elevation of the river's section between the bunds owing to the present embankment system which most Engineers, however, will not admit. It is affirmed by some of them that there are cycles of high floods in the Indus, and that after a period repose will set in; but while observations and meteorological data do not support such conclusions, these conclusions are not based according to the *principle* on which an inundation river acts.

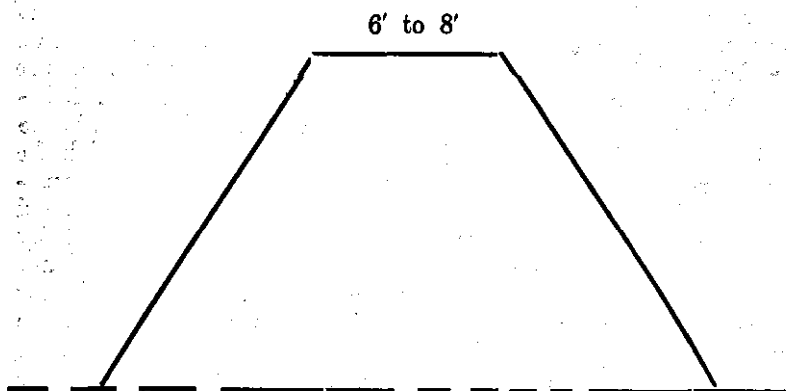
To embank a river like the Indus at all under the circumstances would seem then to be undesirable and opposed to the principle here laid down, and while this is to a certain extent true, there is no doubt that in Sind, where bunds in many places are a *sine quâ non*, it is possible to fix an alignment for them according to observations of growth along the margin of the river which will mitigate the evils complained of. There are three belts of gregarious jungle shown along the margin of the stream, during the *third stage* of its existence, which may be taken as its stage in Sind as far down almost as Kotri Allahrakis (and the embankment system extends some miles below this place) at the present time although in some places these different belts would not be quite distinctly noticed by an ordinary observer. Commencing from the inner toe of the natural spoil bank as it were, the first belt is Tamarisk, then Babul on the summit of the spoil bank and Khandi at the extreme outer toe. According to the experience gained regarding the conditions of soil and moisture necessary for the regeneration of these trees, their existence in the order mentioned along the river supports the theory of the development of the river in the manner already described. It is well known for instance that a certain species of Tamarisk, like the cypress tree of America, affects marshy inundated lands: that Babul requires but little surface moisture and a stiff loam, and that Khandi scarcely any surface moisture and a deep clayey subsoil. According as these conditions exist along the river in its third stage are different jungles arranged. As the development of the third stage of the river continued, the inner toe of the natural bund on which the Tamarisk jungle was

found, would gradually wear away, leaving a more vertical and stable bank on which the Babul stood and the latter would act as a bulwark against the action of the river. (This is what occurred in the Province in many places before the present bund policy was introduced). It was the Tamarisk jungle formerly for the most part that was attacked by erosion—not so much the Babul: the former acted as it were as a buffer to the gradually forming Babul forest. There may have been abnormal natural causes which would tear away the Tamarisk bank and lead to the erosion of Babul jungle as well, but the latter would be but slightly affected. The wear and tear which went on formerly with the river in its natural condition was confined chiefly to the Tamarisk portion of the banks. Huge cracks or fissures would be found in the soil on the Tamarisk banks indicating the existence of excessive moisture in it, which would facilitate the removal of the soil when it became exposed to the action of running water. There can be no doubt that the river banks in Upper and Central Sind on which the Babul forests originally stood, were thought to be sufficiently permanent to withstand erosion, because measures were contemplated when the bunds began to play such havoc at first, of checking it by chaining the larger trees together along the bank but experience makes it palpable that such measures would be absolutely futile for *not all the king's horses and all the king's men would prevent the river working its wicked will on a forest once it made a set on it*. No means exist of arresting the destructive action of the stream on the permanent banks where the Babul exists since the introduction of the present bund policy.

Engineers also affirm that the extensive erosion which is now observable existed anterior to their bund policy and in fact that it has always been in force; but if this be the case, how is it that extensive forests of mature Babul of 8 to 14 feet girth came to be established along the margin of the stream? For such forests to form, it must have taken at least 60 or 70 years or even a century without any intervening disturbance, and yet no new forest of Babul of even 20 years' growth can be seen to have taken the place of those destroyed already. No sooner now is a forest of Babul eroded than a shoal or kacha is thrown up on the opposite shore, which after a few seasons and before any large growth has had time to form on it, is itself swept away. No time in fact is allowed to the land on either side to become permanent. The sectional area of the stream between the artificial bunds is annually being clogged with silt and the river being unable to accommodate its section to the work required of it, swerves aside to a lower level, which is of course the area outside the bunds, and thus scours its way through thickly deposited silt and jungle, clearing away everything as chaff before the wind.

Admitting artificial bunds, however, to be an absolute necessity in a Province like Sind, in many places it is necessary to

ascertain where they can best be built so as to mitigate the evils complained of, and to find out the proper alignment for embankments the particular stage at which the river *is*, must be studied. The bunds as now aligned in the Province, are, it may be mentioned, almost invariably erected before or through a forest of Babul from below Tatta upwards, and they are merely loose earthen mounds thrown up and rammed into a section somewhat as shown in the following sketch. They vary in height as a rule from 4 to almost 14 feet and cost about Rs. 5,000 to Rs. 12,000 per mile to erect.



Obviously no embankments as protective works would be required and would be of any value in the delta, because as previously shown the river branches into two or three channels owing to its passing over flat ground : the velocity of the current is diminished and the deposit of sediment facilitated, consequently the channels are being constantly filled up and new ones are cut through the soft alluvial soil. Small inexpensive zemindari bunds alone in the delta are recommended to prevent slight spills only, rather than the erection of high earthen walls which while being costly cannot possibly, for the reasons given, endure very long. High embankments close to the river bank in the deltaic region would only be recommended if necessary as works of correction, namely to create a scour for the improvement of the navigation of the stream : such embankments in fact as have been erected in the delta of the Danube under the supervision of Sir Charles Hartley, the eminent Engineer, who in his pamphlet entitled "Inland Navigation of Europe" describes in a brief but interesting manner the various works of correction undertaken by him there and their cost. For the improvement of the navigation of one branch of the Danube alone, the expenditure amounted to £220,000, and such a large sum of money it would be almost impossible to procure for Sind and moreover undesirable to spend on training works on the Indus.

In considering the *Protective* measures necessary in the case of a river in the third stage of its existence as already described, the establishing of the most permanent and stable conditions must be objects in view. Such being the case, the old Zemindari system of bunds which existed before the British occupation must be at once abandoned, for these were erected close to the river banks and were only useful to exclude slight spills and were the most primitive measures not intended for a state of civilization such as now prevails. Railway and other lines of communication must be maintained undisturbed all through the year and the large towns and villages must be protected. Where then should the protective walls be erected in such a case?

Certainly not as in the present manner, for they are merely a development of the old Zemindari bund system. Wherever a spill occurs for the first time after a long interval, up goes a high embankment near the margin of the stream.

Another is perhaps erected on the opposite bank subsequently to prevent spill there and thus the river eventually becomes closely hemmed in. The embankments in fact appear to be laid out without a thought beyond present necessity. An observation which it is hoped will be pardoned, but from what can be judged, this is apparently the present policy. Sir Charles Pritchard, it is interesting also to note, when Commissioner in Sind, recorded his opinion that "the double line of embankments (*i.e.*, in Lower Sind) did not seem to have been built in pursuance of any definitely stated and sanctioned project."

Erecting a high bund through or in front of a forest of Babul as is usually done under the present policy, for instance, seems a mistake when viewed in connection with what has been described, because the latter stands on the summit chiefly of the natural spoil bank in process of formation and to obstruct a natural flood sweeping over it, is merely obstructing the river in performing a function (of dredging) which nature intended it should. There must be a sort of natural safety valve for the surplus waters and sediment of the river and shutting off this escape abruptly only causes the river to rebel and to eventually attack the bank.

It is for the sake of providing kharif crops mainly that embankments are erected so close to the cold weather course of the river and on grounds of economy also is such an alignment adopted because, as must be patent, the land near the margin is higher than that further inland and therefore bunds, if constructed in the latter place, would have to be much higher, and consequently more expensive, but objects of present necessity such as these and of gaining perhaps a few acres more kharif revenue *pro tempore* should not outweigh more permanent and what are considered more satisfactory conditions in the long run for the Province.

Hemming in the lateral overflow along both banks with the river in its present stage results in the section of the river

between the artificial bunds being scoured at the expense of the river further down for a few seasons only at first where far more sedimentary matter is lodged in the bed than nature intended. As an instance of the way in which sedimentary matter is swept down in this manner may be mentioned the condition of things in Upper Sind at the present moment, where the river passes through the lime-stone rocks between Bukkur and Rohri and sweeps the bed carrying and depositing most of the sediment near Ruk and Madeji which are situated on flat alluvial soil. The river, when in flood a mighty stream about a mile or so wide, is focussed into this narrow Rohri gorge and it rushes with such swift velocity through this passage that the channel is scoured or deepened there at the expense of the river further down so that considerable tortuous windings in the stream in the region of Ruk and Madeji take place in spite of artificial bunds erected to prevent this, resulting in breaches in the Railway line. Were the bank between Bukkur and Rohri not rocky and permanent, no great scour would result here after a few seasons, because so much sedimentary matter will have been deposited in the lower reaches of the river that the longitudinal slope between the section hemmed in, and that lower down will have gradually diminished and this diminished fall would have resulted ultimately in a diminished velocity of the current and hence deposit of sediment in the section of the river.

There can be only two ways of dealing with the Indus in its present stage in the alluvial plains, and that is either to erect embankments so close to the river and so high and permanent (*i.e.* of masonry) as will create a scour of its channel, and to dredge it all which with the resources at command it would be impossible to afford or to throw them as far back as possible, as far in fact as the *Khandi forest belt* (Fig. 3):—Any half-way or what may be better termed short-sighted policy is bound to meet with ill success and to prove disastrous. The suggested measure may lead to a little loss of Kharif revenue, and the initial cost of the bunds would be more expensive, but rabi crops in Upper Sind, and forest growth in Lower Sind and the reclamation of thousands and thousands of acres of kalar or salt land would more than compensate for this.

By excluding water from porous alluvial soil is kalar land formed in Sind, and as no water from heaven reaches it, the country having practically no rainfall to speak of, this land goes on deteriorating until it becomes eventually unfit even for pasture. Forest Officers could give the Irrigation Department information as to the best mode of treating such land and of making it, in perhaps a dozen years, bring in Rs. 2 to Rs. 3 per acre. If no change be made in the system, expenditure will annually increase, especially in Lower Sind, and year by year more uncertainty and insecurity will exist and demoralization leading to the abandonment of bunds, in some places perhaps owing to the erratic action of the river will ultimately set in. There is

no desire on the part of the writer to take too pessimistic a view of the state of things. It is scarcely correct however to take the optimistic view which some Engineers do who say "We are concerned with the present, let us leave the future to our great grand children to tackle," and again "Our returns show 11 per cent. on the capital outlay and this is good enough." But this is not the question. Is it or is it not necessary to look to the future? It is a hand-to-mouth, a short-sighted policy, which is at all times to be deprecated.

A Forest Administration is bound, as eloquently stated by Mr. Baden-Powell, to look to the future and see that the present generation of inhabitants does not endanger the existence of future generations by attacking the *Capital* when it is only entitled to the annual yield, and a similar politico-economic policy should actuate engineering efforts. What would posterity say if at the present juncture the Forest Department in order to show the highest returns, depleted the forests, leaving almost nothing, and a very difficult problem in the bargain to tackle for their successors? Surely this would be characterised as a very grave blunder? Yet this is almost exactly what the Irrigation Department in Sind, with all due deference to its officers, is unwittingly doing in regard to the embankment system, especially in Lower Sind. In their attempt to gain the highest revenue they are, as it were, killing the goose to get the golden eggs, *i. e.*, raising the bed level of the river and provoking erosion of the stream which leads to the washing away of very valuable land, the very land in fact which the embankment was specially erected to protect. Acres and acres of excellent kharif crop land and high seedling forest yielding Rs. 3 and Rs. 4 per acre which had been established for about a century, and on which improvements had been made, have disappeared in Upper Sind along the right bank within recent times and are now disappearing in Lower Sind, in this manner the bunds having provoked erosion.

No offence it is hoped will be taken at this plain and straightforward criticism—a criticism which is not made in any spirit of opposition, or hostility towards the officers of the Public Works Department, who, it is right to mention, are a very excellent and capable body of men, and no accusation of want of knowledge of their duties is insinuated. That criticism is to a certain extent excusable, however, may be judged from the opinion of one of the ablest Engineers in the Province (for whom the writer entertains the greatest respect) who has read most of this paper; but who does not however uphold the alignment proposed here, but says "I have always condemned the present alignment, but it has been forced on us: not chosen by us. If we had the choice, we should never have put it so close to the river bank.....The embanking of rivers is a question, is it worth doing so? If there is rich valuable land, which if protected, would yield a large return, then it is

worth doing so even though the result may be, judging from the experience of Mayence on the Rhine, a raising of the bed of the river." The same Engineer mentions that he has thrown the bund line back some miles in a certain locality ; but if this policy were generally followed by the Public Works Department, it would be better for the Province. On the contrary, in one or two places where the necessity for erecting bunds has arisen during the past three or four years, or even past year or two, they have been constructed *close* to the river bank as at Meanee near Hyderabad and at Khudee in the Shahbunder sub-division where the bund was swept away before it was completed, and several other instances could be given. What is required in Sind is a steady pursuance of a definitely stated and sanctioned principle which would have to be followed all over Sind and not the present system, which permits one Engineer to do what he thinks expedient in one district, and leaves another to act similarly in his own. Although the protective works in one district necessarily *must* have a very important influence and effect often on the protective works in the district lower down the river. The right hand in fact often does not know what the left hand is doing in regard to Engineering in Sind. Various large canals which are being built and which exist, will not in future realise the estimated revenue from them, because their mouths will be constantly shifting or silting up, or regulators especially in Central and Lower Sind costing thousands of rupees will be required to control the flow of water caused by the apparent high floods in the river each year, and the latter will themselves be subjected to damage and destruction. The Nareja Regulator on the Fuleli, for instance, which cost Rs. 28,000, was washed away in 1894, and annually, sluices in the embankments and the banks of canals are now being carried away.

The whole question it is submitted with all respect is not studied on the *geological footing* it deserves, and the outlook financially and especially politico-economically is becoming a serious one for the Province. According as the development of the present bund system has continued, so have the floods seemed higher and the more securely and successfully they are controlled or hemmed in, the higher will they become till, at length accidental breaches will cause widespread disaster. As evidence of the vast damage that can result from an accidental breach, instance the terrible disaster at Syzedin in Hungary on the Danube in 1879 when the town and its inhabitants were washed away.

Wherever embankments as *protective* works in other parts of the world, also such as in Japan have been erected, the conclusions arrived at after years of experience have been that it is almost safest to leave the river unembanked for the reason that the disasters resulting from heavy floods more than outweighed the benefits previously derived. From the account given by Mr. Vernon Harcourt in his Volume II of 'Rivers and Canals' of the protective

works in other countries this is apparent. It is not known whether the conditions elsewhere, especially in Japan, however, are exactly analagous to those in Sind ; but it is presumed they cannot be very different. Bearing in view the results as stated by Mr. Harcourt, however, without training works at the delta and high permanent masonry walls elsewhere hemming in the overflow closely in the manner effected in Sind, seems an obvious error.

In Lower Sind especially are the evils of close embanking more felt. The natural banks of the river not being rocky as between Bukkur and Rohri and the longitudinal fall of the country being less, the small scours which resulted at first by close embanking have now ceased and the elevation of land between the bunds resulting in the latter having to be heightened. Erosions are beginning to be felt. Breaches, also, owing to high floods, occur almost annually, and large areas such as Khinjar and Sonari Dhunds which were two sheets of water, and which gradually began to shrink and dry up and which had gradually escaped the reach of the river spills before the bunds were erected, have now commenced to receive outpourings from it and to form one large lake, for in 1894 in spite of embankments of about 20 or 25 feet high being erected to prevent lateral overflow, these lakes were flooded. Heavy rains in the hot weather of 1894 assisted to swell the waters of these lakes it is true, but the chief source of supply was the river which will, it is thought, almost annually cause both lakes to fill abnormally for some years. Measures such as are attempted to drain these sheets of water in the cold weather by cutting small channels from them to the rivers, may be likened to draining drops out of the ocean. The original source of the evil, the gradual elevation of the artificial sectional area of the river must be grappled with, and this can only be effected by permitting the stream to have as large a scope for its surplus water for expansion as possible.

If success in the matter of embanking under the *present policy* be desired, therefore works of *correction*, it is repeated, rather than works of *protection*, must be adopted, and bearing in view the resources of the Province which, as already remarked, prohibits their being undertaken, the most economical and most rational policy would seem to be to assist the river to dredge itself and add the mud to its banks as far as possible, and this can be done by adopting a fresh alignment as far back as the *Khandi forest belt*.

But while it is desirable to do this in the flat alluvial plains, one place in the Province exists where it is absolutely essential that the river should be closely embanked and treated as the Danube and that is between Kotri and Gidu, where unless vigorous corrective measures are taken, considerable damage to property at both these places from floods will later on occur.

A certain amount of scour between Kotri and Gidu used to take place formerly, but not sufficient to sweep an abnormal deposit of silt from the bed. Borings and observations taken

for the bridge across the Indus at Kotri show that the depth of sediment in the river bed at this spot before rock is reached is now about 100 feet, but evidence of this nature of the extent of deposit is scarcely required inasmuch as proof of the sectional area of the river, between the bunds not being permanent at Kotri, is observable from a comparison between the gauge readings at Bukkur and Kotri. When the gauges were first constructed, a high reading at Bukkur was usually followed by a reading at Kotri proportionately high. This was before the development of the present embankment system; but the same proportion is no longer maintained. There is a great divergence between the Bukkur and Kotri gauges now: Kotri is as it were outstripping Bukkur in the race. This can be accounted for by the fact that the tendency of the river between Bukkur and Rohri, is, as previously shown, to maintain a constant or even deeper channel, while the opposite tendency results at Kotri where the banks are not permanent.

In 1882 the Bukkur gauge read 17ft. 7in. and Kotri 20ft. 5½in. In 1891 Bukkur showed 14ft. 9in. and Kotri 20ft. 7in., a difference of about 6ft. The present cold weather readings on the 23rd November 1895, are as follows:—

Bukkur 1ft. 5 in. or 11 inches *below* the average of the past ten years, and Kotri 7ft. 3in. or 1ft. 5in. *above* the average of the past ten years.

An examination of the plain below Hyderabad and Gidu shows it to be of alluvial origin, *i.e.*, it has been formed by repeated depositions of sediment caused by lateral overflows and changes of the river course in former times. The stream then, according to geological data must, at one period, when in flood, have spread its waters out as far as the limestone hills on which the cantonment and town of Hyderabad stand, and gradually by a process as described in the preceding pages, subsided within its present channel without practically any spill. The bed of the stream, however, had not become quite constant here, that is to say, the river had not entered its final stage, and this is obvious from the result of the borings now made, but still the process of scour had commenced and it seems clear that had the artificial bund system not interfered with the natural course of things, the natural scour would eventually have taken the river down to the rock, when danger from lateral overflows at Kotri and Gidu would have almost ceased.

But the extra amount of silt carried in the river owing to the protective works above Kotri has been swept down and deposited in the river channel below Kotri, causing there a sort of bar. This deposit has diminished the longitudinal fall of the waters as they pass through Kotri, causing the river to become dammed up as it were near there, and unless very high and strong masonry walls be constructed between Kotri and Gidu, and unless *dredging* also be resorted to in later years danger from floods annually will

occur. The situation as affecting Hyderabad also is getting very serious, for it will in the inundation season be in constant danger of being almost cut off from Gidu by water.

But another evil is also present in consequence of the elevation of the sectional area of the river between the bunds near Kotri and Gidu which will have a disastrous effect on the lands higher up in the Hyderabad District later on. The longitudinal fall of the waters, as explained, having diminished at Kotri, a bar will commence to be formed above that place also, and the rise of the river bed may be expected to go on creeping higher and higher up stream gradually each year until the general level of the river in the Hyderabad District North of Hyderabad has so risen as to cause lateral overflows and erosion all along the left and right banks where they have not been known to occur for a very considerable time. North of Hyderabad along the left bank there were very heavy floods in 1893 for the first time in the memory of the oldest inhabitant.

A new chord line of rail is almost constructed along the left bank of the river from Hyderabad to Rohri in the belief of its immunity from floods but such belief, for the reasons given, will probably in a few years be quickly dispelled. Lateral overflows are bound, it is predicted, to occur and cause breaches in this line later on. The section of the stream above Jamsheð is already commencing to be widened and shoals are being left in the frontage of the riverain forests all of which are certain forerunners of the evils that must eventually arise.

From what the writer knows of the Province he is thoroughly convinced that the policy of throwing the bunds back in the manner explained could be followed with advantage, and that it would ultimately prove of immense benefit to the state. He does not wish to be misunderstood in his remarks. The fact of his being a Forest Officer and desiring the bunds thrown back bears the aspect at first sight of his suggesting such a heroic policy from motives of departmental interest; but such is not the case, although it is admitted, at first the forests will be benefitted by such a policy, because, of course, at present a number of forests are entirely shut off from the river and are suffering in consequence. Throwing the bunds further back and giving greater scope for the spread of the river waters means ultimate extinction of the forests because, as described, the tendency of the river under such a policy would be to heighten its own banks and gradually to fall within them and not cause spill. So that unless artificially treated, the forests would eventually become extinct. It is desired to draw attention to the *principle* on which the river acts naturally and to suggest that the operation of embanking should not in consequence of the paucity of funds for undertaking works of *correction*, run counter to this principle: that it should run in the direction of assisting the process of development which has briefly been

attempted to be explained. No offence it is repeated will be taken at these criticisms which are made in no hostile spirit against a very excellent and able body of public servants, the younger of whom it is only fair to say have not been long enough in the Province to acquire much knowledge of the Indus and have probably remained all their time in one District. Those Engineers moreover who have served for years in Sind have not been able to acquire much knowledge of it from observation because of their time having been spent mainly along canal banks and in making and clearing canals and erecting sluices and regulators. In fact two of the Engineers longest resident in Sind frankly admitted recently that they knew nothing yet of the causes which actuated the river's movements. Had some officer been appointed years ago—as it is believed one now is to be—specially to take observations of the river, the laws which govern its movements would probably now be better understood and grappled with.

That one who is not an Engineer should arrogate to himself the position of critic and should suggest a remedy for the present unsatisfactory condition of things (as unsatisfactory they must be termed in consequence of the almost annual interruption of Railway traffic and the extension of erosion of permanent forest and kharif crop lands) may be thought presumptuous and at first sight ridiculous: but the subject of the best method of embanking the river, as must be palpable, is not outside the pale of forestry. Moreover a Forest Officer's duties take him along the margin of the stream—and as he is constantly brought face to face with its vagaries and is repeatedly reminded of them by being called upon to settle kacha or accretion disputes, he is in probably a more advantageous position therefore to take observations and draw conclusions from the constant fluctuations that occur.

It is through the assistance of Forestry and Geology and not by a total disregard of these subjects that a proper understanding can be gained regarding the best treatment to give the river in the matter of embanking. The banks of the river must be allowed to grow gradually stable, naturally, by forests being allowed to form upon them as explained; and any process opposed to this principle, as the present embankment system undoubtedly is, must end in failure and disaster. It is not known whether the theory laid down in regard to the different stages of an inundation river have ever been propounded before: the writer has certainly neither seen nor heard of any such theory; he has drawn his conclusions entirely from personal observation of the river itself in Sind, and it is satisfactory to find that two of his *confrères* in the Province, one alas! is now dead, who have spent most of their service in this part of the Presidency are able to corroborate the existence of the different belts of growth along the margin of the stream and the different water levels which they affect. The observations of growth are a *vital* element in proof of the assertion of the rise in the bed of the river,

i. e. the sectional area between the embankments. If the river overflowed its banks so heavily in the forests, years ago, as it does now, the particular classes of forests which fringe the river as they exist from near Kotri Allarakis upwards would never have come into existence. The lands would be in the stage of those lower down in the deltaic region where they are flat and marshy and where only the Tamarisk and other useless trees grow. Embanking as is now done in Sind therefore undoubtedly has raised the bed of the river, judging by characteristics of growth on the margin of the stream and that it provokes erosion also. *Cela va sans dire*, when the condition of things in Upper Sind especially is brought to light. Those Forest Officers who have served in Sind must remember how distant the old Aliwahan Bangalow near Sukkur was from the river and how secure the land on which it and the village of Aliwahan stood seemed from being eroded by the river. Yet the Bangalow and lands have all been swept away. Engineers repeat that these sweeps or inroads upon the banks which the river takes have been going on from time immemorial but geology and forestry however answer distinctly *no*.

In conclusion, it is only just to mention that the inundation season of 1895 was lower than the previous year's, but only a few inches below the highest on record, and Engineers would probably submit this as an argument against the theory of the continued annual rise of the water level owing to the river embankments; but one has only to consult meteorological reports to ascertain the real cause of the failure of the river in 1895 to reach a higher level than the previous year. Comparing the reports of the snow falls during the winter season of 1893-94 and 1894-95 the opinion of the Meteorological Office at Simla is as follows :—

"The data (for 1893-94) show that the snow fall was undoubtedly considerable and probably above the average in Afghanistan in the mouths of January and February and was larger in amount than in the previous winter * * * * The snowfall was undoubtedly excessive in the higher Ranges of the Kashmir and Punjab Himalayas and was abnormally heavy in Ladakh where it was in the opinion of the natives of the district unprecedented."—

It is hence almost certain that there has been less snow during the past winter (1894-95) in Persia, Beluchistan, Afghanistan, and probably Turkistan, Thibet and Central Asia and that the winter ceased usually early and was very mild. The snow fall for the past season was heaviest in the Kashmir and Punjab Himalayas, and was undoubtedly much heavier than usual in December and January. It was very heavy in the interior ranges but the heavy snowfall did not extend in the upper Indus Valley and the Karakorum Ranges as in did in 1894. This is further confirmed by the fact that no snow fell at Kashgar during the season and that the fall at Leh was very small." These extracts exhibit the

combination of heavy to excessive snowfalls during the winter 1893-94 while the snowfall in 1894-95 was smaller than in the previous year. Although the snowfall during 1893-94 was excessive, it appears not to have been more so, however than in 1867-68 1877-78, 1882-83, 1884-85, 1888-89, 1890-91, 1892-93 (*vide* Meteorological reports for 1894-95).

Yet during the inundation period of 1894 the floods in Sind were the highest on record : bunds were breached in every direction, Railway traffic was impeded for a considerable time and the town of Kotri was submerged. The snowfall during 1894-95 being smaller generally than in 1893-94 accounted therefore for a lower inundation in the flood season of 1895 than in the previous year. The gauge readings in November 1895 at Kotri were higher than those of last year, but it does not follow at all that the flood will be higher in the Summer of 1896 than during the previous inundation. To accurately estimate what sort of flood may be expected therefore it will be necessary to consult meteorological reports in order to ascertain the snowfalls of the current winter.

The river Indus for its continued and steady rise does not subsist on rainfalls at all, but on snowfalls at or near its sources and those of its five tributaries. Heavy rain in the Punjab may cause a temporary flush in the hot weather but for a persistent steady high flood, as there was in 1894, snowfalls undoubtedly form the important factor.

G. M. R.

3rd February, 1896.

The Indian Forest Department and Coopers Hill.

In our number for December 1895, an article on the "Recruitment of Officers for the Indian Forest Service" appeared under the initials "C. G. R." In that article it was said: "The position of the Inspector-General of Forests is analogous to that of a Chief Engineer, while Conservators of Forests correspond to Superintending Engineers of the Public Works organisation, so that if, as stated in the regulations under consideration, the Forest Officers are on an equality with Public Works Officers appointed from Coopers Hill, then it must be the intention of the India Office to extend to Conservators of Forests, the Rs. 1,000 a year extra pension that has already been accorded to Superintending Engineers, and we hope that the Indian Government will recognise this and make the necessary alterations in the present pension rules of the department at once" and we then drew the attention of our readers to an extract from the *Indian Engineer*, which we reprinted at pages 480 and 481, in which it was suggested that candidates for the Forest Department of India ought to know that the Coopers Hill prospectus does not fairly explain the conditions of service.

We have now received the following letter from England, which we give in full :—

"On page 480 of the *Indian Forester* for December 1895, it is said 'that in the Forest prospectus of Coopers Hill for December 1895, mis-statements are made as to the rules that 'regulate the pensions of the 'superior grades of that department and of the Public Works and Tele-graphs' and that the statement that as regards pensions 'the Forest 'Officers appointed from England are thus placed on an equality with 'Public Works Officers appointed from Coopers Hill is incorrect and 'misleading."

"This criticism overlooks the fact that the concession granted for 'special reasons, whereby Chief Engineers were eligible for an additional 'pension of Rs. 2,000, was withdrawn by Lord Kimberley's despatch of '21st September 1893, and that under the operation of that despatch, 'from the end of 1893, the same orders govern the award of pensions to 'recruits thereafter entering from Coopers Hill College, either the Public 'Works, the Telegraph, or the Forest Department.

"So long as these orders last, the selected forest candidates of 1894 'and subsequent years undoubtedly enjoy the same pension rules as their 'contemporaries in the Public Works Department."

A. T.

It is thus claimed by our correspondent that we were wrong in our article of December last, and that the *Indian Engineer* was wrong, and that the recruits from the Coopers Hill College who have entered the service since 1893, whether in the Public Works, Telegraph or Forest Departments, are really all on an equality as regards special pensions. He says that in that year the special additional pensions of Rs. 2,000 allowed by S. 714 of the Civil Service Regulations to Chief Engineers of the Public Works Department, and the Director-General and Deputy Director-General of Telegraphs, were withdrawn by a despatch of the Secretary of State, but he is probably unaware that there is no mention of that despatch in the Civil Service Regulations, and that in the 2½ years that have elapsed since the despatch referred to, Sections 714 to 716 have not been altered.

A reference to our copy of the "Civil Service Regulations," a copy which is very carefully corrected as Addenda—Corrigenda slips are issued, shows that S. 714 runs as follows :—

"714. The following special additional pensions, over and above 'these allowed in Article 712, may be allowed by the Government of India 'as rewards of approved service in the responsible positions referred to 'below :—

(a) *Additional pension of Rs. 2,000 per annum to those who have served three years as—*

- (i) Chief Engineers, or officers who may have been graded as such.
- (ii) Director-General, or Deputy Director-General of Telegraphs.

(b) *Additional pensions of Rs. 1,000 per annum to those who have served three years as—*

- (i) Superintending Engineers.
- (ii) Director of Construction; Director of Traffic or Superintendent, 1st grade, in the Indian Telegraph Department.

(iii) Directors of the Persian and Persian Gulf Telegraphs in the 'Indo-European Telegraph Department, &c., &c., &c."

The Coopers Hill prospectus runs thus :—

"The more favourable pension rules have recently been extended to Forest Officers appointed from England, who are thus placed on an equality with Public Works Officers appointed from Coopers Hill College. Any Forest Officer who has rendered not less than three years' approved service as Head of his Department, has also been made eligible for an extra pension of Rs. 1,000 per annum."

These were the statements which, when our December number issued, contrasted the position of Forest Officers as regards special pensions with those of Public Works and Telegraph men. What the Secretary of State exactly meant by "Head of his Department" requires more definite interpretation no doubt, but there can be no question but that the Inspector-General of Forests is the head of the Forest Department in the Bengal Presidency, and that the Conservators of Forests under the various Local Governments and Administrations have always been reckoned as Heads of Department in their Provinces, whether there have been one only or more than one Circle in those Provinces. The Inspector-General of Forests (pay Rs. 2,000, rising to Rs. 2,500) is on an equality as regards pay and position, with Chief Engineers or the Director-General of Telegraphs, and Conservators of Forests (pay Rs. 1,100 to Rs. 1,600) are on an equality with Superintending Engineers, whose rates of pay are the same. Consequently, if the Forest Rules are the same as the Public Works and Telegraph Rules, the Inspector-General would be eligible for the additional pension of Rs. 2,000, and Conservators of Forests for that of Rs. 1,000, but the Coopers Hill prospectus does not give us this, and therefore we consider that our correspondent's statement and the statement of the *Indian Engineer* were quite accurately representing the facts the writers had available before them when they wrote as they did.

Since our December number issued, we have received a copy of the Secretary of State's despatch No. 230 of December 26th, 1896, and copy of it was issued as page 103a of our March number. That despatch refers to the one No. 188 of September 21st, 1893, which our correspondent alludes to, but does not give the substance of its order, so that as far as we Forest Officers in India are concerned, we are still officially ignorant of it. It would seem probable that even Public Works Officers are ignorant of it, for it is hardly likely that an alteration of the Rules which withdraws from Chief Engineers what must be one of their most important privileges, would escape the comments of the press and be allowed to pass without protest by the department. We do not remember to have seen any press allusion to the subject.

Turning to the new orders of the Secretary of State in the despatch of December 26th, they run as follows: "The Forest Officers, whether at present in your service, or hereafter to be ap-

'pointed, will be entitled, if recommended for special merit, to an 'extra pension of Rs. 1,000 per annum after three years of approved service as the Head of the Department in any Province." Assuming that this cuts out the Inspector-General altogether from his expected Rs. 2,000, which in itself would be a shame, it is at any rate satisfactory to note that in this case it is the "Head of Department in any Province" who is to get the concession. This can only mean that, at any rate, *some* Conservators will be eligible, and most probably *all*, for it can hardly be intended that a 3rd grade Conservator in Berar or Assam is to get a special pension which is denied to a 1st grade man in Burma or Bombay, where there is more than one Head of Department.

With every possible respect to our correspondent, who we think has himself been misled, we are bound to say that until definite clear orders are issued and inserted in the Civil Service Regulations, naming together the Public Works, Telegraph and Forest Departments, we shall still claim that the Coopers Hill prospectus is misleading, and that the statement that Forest Officers are on an equality with those of the Public Works is not borne out by the official orders of the Government in India. We will conclude our remarks by a quotation from the *Pioneer* of the 2nd November 1895, which will shew our correspondent that the *Indian Engineer* and the *Indian Forester* were not alone in their opinions on the subject. It is a great pity that the enthusiasm of the officers of a hardworking department should be checked, and a sense of injustice be fostered for the sake of the miserable saving effected by the refusal to allow what they have been given to understand they may expect as a right. It is a pity that it should take so long to induce the Secretary of State (the Government of India itself has supported us as the despatch shows clearly) to grant the concessions which we have fairly claimed, and that his refusal should have been conveyed in such curt language as that of Lord George Hamilton's despatch. It took us something like 15 years to get the Public Works pension rules extended to ourselves, and it may take as many more to ~~get the~~ special pensions extended, especially if, as would seem not unlikely, Public Works Officers are not content to abide by the orders of 1893, which the Government of India have apparently not yet been able to insert in the Regulations.

"The usual Coopers Hill prospectus for the Indian Forest Service examinations has just been issued. It contains nothing new, but it is again repeated in paragraph 17 that 'the more favourable pension rules have recently been extended to Forest Officers appointed from England, who are thus placed on an equality with Public Works Officers appointed from Coopers Hill; any Forest Officer who has rendered not less than three years' approved service as Head of his Department, has also been made eligible for an extra pension of Rs. 1,000 per annum.' This is a most misleading statement, for although Article 712 with its scale of pensions has been extended, Article 714, under which Chief

‘Engineers and certain Telegraph officers are eligible for Rs. 2,000 extra, and all Superintending Engineers for Rs. 1,000 extra, has not been extended to the Forest Department. In short, under the existing orders, only the Inspector-General is eligible as the Head of his Department for an additional pension of Rs. 1,000. The Government of India have for years in numerous despatches recommended that for purposes of the extra pensions under Article 714, the Inspector-General of Forests should be classed as a Chief Engineer, and Conservators of the 1st and 2nd grades as Superintending Engineers. It rests with the Secretary of State to sanction these proposals and to place Forest Officers on an equality with their fellows in the Public Works Department as is now incorrectly said in the Coopers Hill prospectus to have been done. As the matter stands, it might be understood from that prospectus that all Conservators of the 1st, 2nd and 3rd grades would rank as Heads of the Department and qualify in the same way as Superintending Engineers for the additional Rs. 1,000; and it is not unlikely that some day the Government may find it difficult to disqualify retiring 3rd grade Conservators for the extra pension. As a matter of fact the number of Conservators of the 1st and 2nd grades, bearing approximately the same proportion to the department as Superintending Engineers do to that of the P. W. D., the desired equality in pension prospects is arrived at by making the concession only to those two grades and not to Conservators of the 3rd grade. The position is about as unsatisfactory as can be, and candidates for the Forest Service should know that the Coopers Hill prospectus does not fairly explain matters.”—(*Pioneer*, November 2nd, 1895).

Forests in the Telbal Valley, Kashmir.

This valley is situated a few miles to the north-east of the city of Srinagar, and is traversed by the Ara River, which has its origin in a lake known as Mar Sar, and flowing in a westerly direction, runs into the Dal Lake near Shalimar Garden. The river at its highest has a considerable volume of water and is capable of carrying small sized logs. The construction of the dam for the water supply of Srinagar at the village of Harwan above Shalimar will, however, necessitate special arrangements for floating: at present nothing but firewood is brought out in small pieces. As usual, the hillsides on the right bank of the river, having a southerly

aspect, are bare of trees, though valuable as grazing grounds, and from the great extent of pasture land there will be no hardship in limiting the village grazing to this side of the valley, while the young forests on the left bank are allowed rest. All forest growth is confined to the hillsides above the left bank of the river Ara, and generally consists almost entirely of broad leaved species, such as wild fruit trees, *Parrotia*, hawthorn, *Cotoneaster* and other shrubs with some poplar in the lower part of the valley. In the higher elevations there is some growth of inferior pines, but deodar does not occur, except as isolated trees here and there. Further up the valley towards the village of Dachigam, horse-chestnut, maple, &c., are found; the shrubby undergrowth comprises the usual species such as rose, *Viburnum*, *Lonicera*, raspberry, *Staphylea*, *Spiræa*, barberry, and so on. Above Harwan there are five villages known collectively as Panzgram, individually they are Tropher, Babgam, Nagpura, Wanpura and Draphama.

Above these villages up the valley is Kaopura, which was formerly called a rakh or place, where State cattle were kept. Further up again stands Dachigam, the last village on this stream, though there are some small Gujar hamlets adjoining the lands of the village. Between Harwan and Kaopura the forest growth is little better than scrub jungle, but if closed to felling it will rapidly improve. The really good forest begins from Kaopura, and extends up to Dachigam along the left bank of the stream. At Kaopura a nala joins the Ara River, containing a very dense forest of hard woods which shows no signs of felling in the past, probably because it was further away from the river than the forest higher up the valley.

Immediately above Kaopura on the main stream is the first place where trees have been felled for firewood for Srinagar supply. The forest here descends quite to the water's edge, so this place was naturally chosen as giving the least trouble in extraction of the produce, and just as naturally every tree has been cut in the area operated on, indeed the general look is that of a fire swept blank, and what is worse, for some reason, the poh (*Parrotia*) has not coppiced after felling. High above this near the crest of the range is a small forest of budlu and ré (*Abies Webbiana* and *Smithiana*) with a few kairu intermixed and even an isolated deodar here and there.

Opposite Dachigam to the south is a nala known as Sundar Nár: this contains very thick forest, mostly of hard woods; but at a higher elevation there are conifers, and among them a few deodar. About half the area in this side valley consists of grassy blanks. No fellings have yet been made here. To the south-east of Dachigam is the large nala, called Nawan Nár, which joins the Ara River at the lime quarries: these appear to have only lately been discovered, and are now being worked for the dam at Harwan; the limestone seems to be of excellent

quality, and as Dachigam is only four or five miles from Harwan along an easy road delivery should be very inexpensive. The Nawan Nār contains very good hardwood forest, especially in the higher elevations, but the eastern slopes on its left bank have many grassy blanks; the head of the valley is well covered with forest. The slopes on the right bank with a southern aspect are as usual quite bare of tree or shrub vegetation, but are useful as grazing grounds for the village, and there will be no hardship in closing portions of the forest clad slopes on the left bank. There is not much forest of any value any distance above Dachigam up the main stream of the Ara River; on the left bank where the slopes have a northern aspect, the forest is good for a mile or so, but after that it becomes poor and the hillsides very precipitous, having only a few conifers here and there.

In short, in the Telbal, or, as it is also called the Dachigam Valley, the forest growth is confined to the left bank of the Ara River, and even there the slopes facing the east are grassy blanks, while at the lower end of the valley the summit of the range is also bare of trees; the area under forest is therefore not very extensive, but being so close to Srinagar it is of the greatest value for the supply of firewood, and, perhaps, in time it may be possible to extract pine timber in short lengths, but not at present prices. Hitherto the felling has been confined to the tract lying between Kaopura and a point about a mile above Dachigam, and for firewood alone trees of all sizes have been felled, though probably none of them exceeded two feet in girth; every part of the tree was extracted, except the smaller branches. The firewood is usually cut into what are known as *halbas* or pieces about 18" to 24" in length, though in the case of the thicker pieces these were brought out as long as four feet. The wood is cut into pieces one year and left to dry in the forest till next year, it is then thrown into the river, and partly floating, partly rolling along by the great force of the stream is carried down to what is known as the *ghât* near Shālimār; here it is caught and collected on the bank and finally taken in boats to the city by way of the Dal Lake.

As regards the question of grazing it is a very simple one, there are very few villages, the whole of the slopes on the right bank of the Ara River are grassy blanks; the area is more than sufficient for many more cattle than the villagers possess; the valley is a narrow one, so that these slopes are quite close to the villages, at any rate such as are situated above Harwan, there would, therefore, be no hardship whatever in closing the whole of the forest clad area on the left bank if it were considered advisable, much less therefore in closing a part; this is especially the case at Dachigam where, owing to the large area left undemarcated, there is not the smallest necessity for cattle going into the forest.

The forest area in the lowest part of the valley just above the water-works dam up to Draphama ought to be strictly closed to all grazing, though it might be allowed in the grassy blanks near the crest of the ridges. Closing is necessary, both in order to allow the forest to recover past bad usage and also in the interests of the water supply. On the whole, forest matters are very hopeful in this valley, the growth is good, the fellings have been hitherto comparatively small, so that considering its proximity to the city the tract is very valuable for the firewood supply.

It is said that the Nakshbandi Jagirdar, who lives on the other side of the range on the shore of the Dal Lake at Brain, has cultivated a plot of land in the Ara Valley high above the village of Kaopura ; if so, he should be ousted from it or he will make some claims on the forests.

The village houses in this valley are built of sundried bricks, double-storied, with a balcony ; very little wood is used. Here there is no necessity for *pine* wood being given for building ; the poh (*Parrotia*) grows to a very large size, and being a hard wood, it is just as durable as pine and nearer to hand than the conifers.

The lower boundary of the forests in this valley was completely demarcated by the Conservator in person during the spring of 1894 ; this will at any rate save them from being damaged or broken up for cultivation ; as soon as possible the demarcation should be completed and a boundary survey made.

J. C. McDONELL,
Conservator of Forests,
Jammu and Kashmir State.

The Brow-antlered Deer or Manipur Stag (*Cervus Eldi*).

This deer is not found in India proper and a short account of the habits, &c., of the animal may therefore be of interest to some of your readers in India and elsewhere.

The *Cervus Eldi* or Eld's deer, so called after Captain Eld who discovered the species in 1838, is known in Burma as the Thamin and Sangnai or Sangrai in Manipur. In size, the stag stands nearly 12 hands at the shoulder, the doe being a few inches smaller. In its winter coat, this deer presents quite a different appearance to what it is as seen in the summer months, and this has led some sportsmen to think there are two varieties of this deer in Burma. In its summer coat, that is from spring to autumn, this deer is known as the Thamin-wan (Wan=yellow) to the Burmese, at the end of autumn it changes its coat to a

dark brown and becomes, especially the buck, a much more shaggy looking beast, and it is then known as the Thamin-wet (Wet=pig). I have never shot nor heard of any one else shooting a yellow stag in December or a brown one in June. In summer, the hair is short, of a dun colour spotted white, like a Cheetal (*C. axis*). The Thamin of Lower Burma is said not to be spotted except fawns. This is not so in Upper Burma, and the white spots are very distinct in all ages during summer; and even in its winter coat, with the light at the proper angle, the spots can be made out. The following are the measurements of the largest specimen shot by me in Upper Burma, and the head now adorns the walls of the Dehra Dûn Forest School Museum.

Horns, brow	14 ins.	}	= 52.5 inches.
beam	38½		
Greatest divergence			= 25 inches.
Circumference above burr			= 7 inches.
Nose to end of tail			= 45 inches.
Girth at shoulder			= 43 inches.
Weight (uncleaned)			= 270 lbs.

Below are the measurements of a few good heads:—

	I	II	III	IV
Right horn, tip to tip,	50 ins.	49 ins.	46 ins.	49 inches.
Left " " "	51 ins.	49 ins.	46 ins.	47½ inches.
Greatest divergence	33 ins.	29 ins.	27 ins.	28 inches.
Circumference above burr	5 ins.	5½ ins.	4½ ins.	6 inches.

The Thamin horns in Lower Burma have a much greater divergence than heads procured in Upper Burma.

The brow-antlers are of course the most peculiar feature of this deer, being very prominent, they are scimitar shaped, projecting forwards, slightly inwards, then downwards, and finally upwards. The main beam has generally only one bifurcation, though at times abnormally developed heads are met with. The Tres-tine, as is the case with the Cheetal (*C. axis*) and the Hog-deer (*C. porcinus*) is developed at the expense of the Royal, which in many heads is only a snag. There are frequently points on the upper surface of the brow-antler and generally one or two prominent snags in the axil, the main beam is unbranched for two-thirds its length and is curved backwards, then outwards, and lastly forwards; towards the end it bears a number of small points varying from 3 to 10. The greatest number of points in a head, which I have heard of, is 18, but a great many of these are merely snags and can hardly be called points. For example seven or eight of them would not suspend a wine-glass, which is the method adopted in counting the points in the head of the Red-deer of Europe.

The Thamin is distributed over the valley of Manipur and thence southwards in suitable localities throughout Burma and the Malay Peninsula; always in flat alluvial ground. In Lower

Burma the Thamin inhabits swampy plains and kaing grass patches, known as kwins, between paddy cultivation: in Upper Burma it is found in light scrub jungle, never in dense forest. The Thamin is gregarious, being found in herds of from 10 to 50, sometime more. In winter, the parties are smaller and consist almost entirely of does, the stags keeping to themselves singly. Bucks which have newly shed their horns also separate from the herds as they are annoyed by flies and by the does which lick the tender stump or pedicel. Stags begin to shed their horns in June in Manipur, September in Lower Burma, and June-July in Upper Burma. Horns are not shed annually, and Burmans say that the Thamin sheds its horns only once in three years. The rutting season lasts from May to July, and the young are born in November-January, the period of gestation being seven months; the young are generally born one at a birth, and are of a light fawn colour, spotted white. The males begin to acquire horns in the second or third year and are in their prime when six or seven years old. The female has a short barking grunt, the call of the male is lower and more prolonged. Their call is however very seldom heard.

Stalking Thamin affords very fine sport when they are to be found in scrub jungle. When disturbed, however, this deer at once makes for the open, a grassy plain or paddy field, where it cannot be approached. In Lower Burma where they inhabit kwins, the only way to get them is from an elephant as the kaing grass is very thick and difficult for beaters to work their way through. By far the easiest way to shoot this deer is to go after them in a country cart, when they will allow you to approach them up to 40 or 50 yards in the open, being almost as curious and confiding as a doe Cheetal. This method is generally adopted by the *sporting* Burman Myook, who goes out armed with a smooth bore charged with slugs and does not discriminate between a doe and a stag.

TAW-SEIK.

Wood-gas for Lighting Towns.

The town of Deseronto (Canada) is lighted with wood-gas, says the *Moniteur Industriel*.

This gas is made in tanks full of sawdust, heated by a wood-fire. From the tanks extend a series of worms to distil the gaseous products.

On leaving the purifying apparatus, the gas has a less disagreeable smell than ordinary coal gas, something resembling that of the smoke of a grass fire. Two tons of sawdust produce 548 cubic metres of gas. The light is from 18 to 12 candle-power. Resinous woods are best. Finally the manufacture is less expensive than in the case of coal. We have here perhaps a better means of utilising sawdust, even than by making it into charcoal (*Révue des Eaux et Forêts*, December 1895).

Iron-bark in New South Wales.

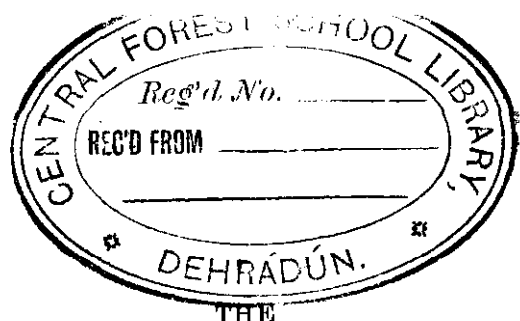
For some time past the New South Wales Forestry Department has been making inquiries about the available supply of ironbark timber on Crown and Reserved lands in New South Wales available for railway sleepers. Estimates have been obtained from the forest rangers in various districts ; but although in some cases the returns forwarded have been very complete, in other cases the information obtained has been meagre. The statistics compiled from the returns show that there is an area of 6,196,000 acres of ironbark lands belonging to the Crown or in reserves in the colony. The estimated number of matured ironbark trees on this area is 16,870,000, which are calculated to contain 167,500,000 railway sleepers. These figures do not, of course, apply in any way to alienated lands. For instance, the 400,000 sleepers required for the Narrabri and Moree line were nearly all obtained from private lands. Taking into consideration the fact that the bulk of the ironbark lands of the colony is now in private hands, it is believed that the total available supply of ironbark in New South Wales might be roughly estimated at about 500,000,000 sleepers. This would be enough, not counting renewals, for somewhere about 250,000 miles of railway.—(*Engineering*).

Knots in Timber.

Timber without knots is almost as rare as fish without bones, and yet, for many purposes, knots must be considered as *defects* which depreciate the value of wood to a greater or less extent. Where wood is exposed to friction, as in flooring, or to strains which try its transverse strength, as in rafters, laths, joists, &c., knots are highly detrimental to the utility and efficiency of the goods made from it, and an endeavour is always made to cut such from the lower part of the stem in which the knots are small and extend but a short distance from the centre. The most objectionable form which knots assume is when they consist of plugs of dead wood embedded in the green or fresh timber, having no greater connection with the latter than a nail or staple driven into the wood. Thin boarding or laths containing these dead knots are

of low value, as the knots are apt to drop out when the surrounding wood begins to shrink, leaving cavities and weak places in the wood. Green knots also weaken the transverse strength of wood by interrupting the fibres and weakening the elasticity of the wood, but as they are nearly of the same hardness and texture as the surrounding tissues, and do not interfere with the cohesive strength, they are more readily tolerated than many other defects commonly found in timber.

It is probably the seller rather than the user of timber who loses most through the presence of knots, however. Sometimes, it is true, a timber merchant may purchase what is apparently a fine, sound stick, but which turns out partially useless owing to the presence of dead knots or defects caused by early injuries to the stem. But such instances are rare compared to those in which the purchaser declines to give account of their rough and knotty character. Those who have the slightest acquaintance with the buying and selling of timber know how unsatisfactory to both parties is a transaction over a lot of small, short-boled and heavily branched trees, and in many cases the price obtainable scarcely covers the cost of felling and making good the damages caused by its removal. It must also be borne in mind that the cost of felling timber is inversely proportional to the cubic contents of the trees. It costs no more, and in most cases less, to throw and trim a tall tree with a clean bole of forty or fifty feet and comparatively small crown, than it does to treat a low, wide-crowned tree in the same way, while the cost per cubic foot in the latter may be five or six times as great as that in the former, and the same applies to the subsequent handling of the log. These points are really at the bottom of the low prices which British-grown timber fetches in the market. The top prices given at timber sales for exceptionally fine trees are usually the double, and sometimes the treble of the average, and the keen competition for really good timber proves how ready timber buyers are to appreciate high quality. The prevalent custom in this country of thinning young woods too freely before the stem cleaning process is thoroughly completed produces trees with short stems and deep, wide crowns, owing to the unrestricted development of the latter never being checked by crowding. Imported timber, on the other hand, is usually selected from trees which have been drawn up in competition with their neighbours, and have early lost the side branches of the lower part of the stem. For English grown timber to successfully compete with foreign, they must be grown under the same conditions as the latter, and also be subjected to the same careful sampling and treatment after felling. Knots and lack of proper seasoning are the two great faults of our native timber, and until these faults are remedied, we cannot look for much improvement in the price. (A. C. FORBES, in the *Timber Trades Journal*).



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The Forests and Fauna of British Central Africa.

There is but little to interest the traveller in the way of scenery on the east coast of Africa, as viewed from the deck of a steamer proceeding from Aden to Natal. Low sandy hills sparsely covered with thorny scrub jungle fringe the beach, whilst interminable mangrove* swamps line the banks of the rivers, and extend over such portions of the shores as are swampy and inundated by the tides. Here and there, a solitary Baobab† may be seen towering over the rest of the bush, whilst small islands are passed covered entirely with Casuarina.‡

At the Chinde mouth of the Zambesi river is situated the small British concession obtained from the Portuguese Government and used as a bonded warehouse. Within the concession no one is allowed to reside except the British Consul, the local Manager of the African Lakes Company, and the Manager of Sharrer's Zambesi Traffic Company. The Post Office is situated in the Consulate.

The banks of the Chinde river itself, and of its various channels are densely covered with mangrove forests which extend about 15 miles up the river. Beyond this, and outside the belts of mangrove are enormous marshy plains, with a very few acacias scattered about at long intervals. These plains are covered with high grass and reeds, and are the resort of both red buck and waterbuck. In the river, and in its numerous channels, hippopotami are fairly numerous. They occasionally enter the sea and thus travel from the mouth of one river to that of another.

The Portuguese have established a settlement outside of and adjoining the British concession, where Portuguese law, such as it is, is administered. For grave offences the punishment is transportation to the Portuguese colonies on the west coast of Africa; for minor offences, a liberal allowance of "Chikotee" (raw hippo-hide whip) is given.

* *Avicennia officinalis*. † *Adansonia digitata*. ‡ *Casuarina equisetifolia*.

A Commandant is in charge of the settlement, and obtains a considerable revenue from Customs duties, and the sale of mangrove timber and firewood—the latter being extensively used for fuel on the river steamers. Of course the mangrove forests are not worked on any system whatever, but the fuel is cut by the Manganjas wherever most convenient, and transported in boats to the wooding stations, as they are locally called, which are situated every 15 or 20 miles along the river banks. Almost all the buildings in Chinde are constructed of mangrove and corrugated iron. The mangrove poles being beautifully straight, and the timber dense and sound, there is very little labour expended in the erection of a building.

Travelling up the river by steamer, the small and neat Portuguese station of Zompa is passed, and a few miles further up the Zambezi is entered some 22 miles from Chinde. The country here is uninteresting and flat, mostly flooded in the rains, and consisting of extensive grass plains fringed by a thin forest of acacias of various species.

As there is great danger in travelling at night, both from concealed snags, and vicious hippopotami, all river steamers are tied up to the banks at night, whilst the crew, mostly Manganjas and Chikandos, land and cook their food. At daybreak, the steamers proceed again on their voyage, and if all goes well, travel from 40 to 60 miles a day; but everything depends on the force of the current, and the position of the shifting sand banks on which steamers often get stuck for several days.

The scenery is much the same till the Shupanga forest is reached, when low hills covered principally with acacia forest, and scattered palm trees* come into sight on the south bank of the river. This forest is a very extensive one, and meets the Gorangoza forest, from whence the traveller can get to the seaport of Beira.

Proceeding north, the steamer leaves the Zambezi river, and enters the Shirè which averages about 150 yards in width, though in many places it is very much less. This river teems with crocodiles, of which immense numbers may be seen floating in the water, or sunning themselves on the sandbanks. The spurwinged goose is fairly abundant and the Egyptian goose may occasionally be seen; but ducks, during the season, are in thousands, and the varieties of other waterfowl innumerable. Hippopotami are somewhat rare, having been shot down and frightened away by the numerous shooters on board every steamer, who keep up a constant and daily fusillade, and fire at every living thing they see. The two gunboats stationed on the river have also much to do with the destruction and frightening away of the game, for the officers and men are constantly out shooting (having little else to do) and the latter even give their weapons to the natives, and send them out to destroy the game.

* *Borassus flabelliformis*.

Proceeding up the Shirè, the Morampala Mountain on the east bank gradually comes into view, and as the steamer goes close to and completely round its southern base, a very good view is obtained of the forests. These are entirely deciduous, and run up to about 3,000 ft. elevation, above which is grass, with patches of evergreen forest in the valleys, and on the crest of the mountain, on its southern side.

A Missionary settlement was established on the small plateau at the summit, and the Missionaries planted an orchard there but subsequently shifted their quarters and abandoned the settlement. A planter of the name of Simpson made a small coffee estate on Morampala, and established a store at the foot of the mountain near Inhasugwengwe, but the Portuguese, with their usual rapacity, found a pretext for confiscating his property and driving him away.

From Morampala, parallel ranges of hills run north and south on both sides of the river, the valley of the river being a great marsh, known as the Pinda marsh. The country is perfectly flat on both sides of the river to the foot of the hills, which in some places is about fifteen miles distant, in others only three or four.

About 20 miles north of the Pinda Marsh, British territory is entered. A sign-board on the south bank informs the traveller of this fact. A few miles further, and the next little station of Port Herald is reached. A perfectly straight road bordered with clumps of plantains, and handsome little trees of * "Pride of India" leads to the Assistant Collector's house, a brick and iron building with a broad verandah round it. Other roads laid off at right angles divide the settlement into convenient blocks, which are available for sale; but at present only two blocks seem to have been taken up and built upon. At the back of the settlement and to the north of it a dense evergreen wood is situated almost touching the station, and is a favourite haunt of both lions and panthers, which have proved exceedingly troublesome at times. It is unsafe to walk about the station at night on this account. In this wood are numerous lofty white stemmed *Sterculias*, in which Marabout storks build their clumsy nests. The Sausage tree † is also common, and remarkable for its extraordinary looking and enormous fruit. Scandent on the loftier trees, is the handsome Kombé ‡ creeper, with its large whitish lilac flowers and curious hornlike pods, from the seed of which is obtained the deadly poison with which the Manganja smear their barbed arrows. This poison will kill an animal of the size of an eland in nine hours.

This is the first evergreen wood to be seen on the banks of the Shirè. Such woods are by no means common, and are only to be found in damp situations on the banks of streams or water-courses at rare intervals. The real Manganja term for them is

* *Melia Azedarach*. † *Kigelia pinnata*. ‡ *Strophanthus Kombé*.

"Insétu" plural "Masétu." The principal trees to be found in them are Acacias, tamarinds, baobabs, Sterculias, Kigelias, and numerous leguminous trees. The undergrowth consists principally of a thorny scandent *Cæsalpinia*, and various undershrubs, all more or less thorny and impenetrable. The only means of getting about inside the "Masetus" is to follow the rhino pathways, or old elephant tracks; but even then the labour is very great. There is considerable danger as well, of stumbling on a rhino or a lion asleep; besides which these strongholds are the favourite resort of panthers, hyenas, wart-hogs and buffalo. The only other animals that inhabit them, are the harnessed antelope, the bush buck, and two species of small antelope no bigger than a hare; of course they are full of vermin, in the shape of cats, mungooses, snakes, &c.

After leaving Port Herald, Chiromo is reached—some 70 miles distant. There the traveller's baggage is overhauled, and Custom duties exacted from him, after which he is free to travel in any part of the Protectorate.

My first trip was to the Elephant Marsh which lies principally on the north bank of the Shirè, a few miles from Chiromo, and extends northwards for a long distance towards Katunga's village. The marsh consists of more or less flat land sloping gently from the village of Mota at the base of the Shirè Highlands to the river, and across the river southwards it trends upwards towards the Ku-Pande Hills. The whole of the marsh is intersected with shallow channels, from 10 to 20 ft. wide and 5 or 6 ft. deep, by which the flood waters drain off into the river in the dry weather; and has, interspersed over it, hollow depressions of an acre or two in extent, in which the river water is retained. The canals are bordered with spiny-leaved "Bango" reeds, which afford cover to both lions and buffalo, with which the marsh abounds. These covers are dangerous to approach too close. A considerable portion of the marsh on the southern side is covered with a dense growth of an annual, something like wormwood in appearance, but more succulent. During the summer floods this plant dies; but remains standing. There are many hundreds of acres covered with it and as it grows from 10 to 15 feet high, it affords sufficient cover to wounded buffalo, and it is very dangerous to enter it. It is a wonderful sight to see a large herd of buffalo a thousand strong crashing, in their headlong flight, through this dry brushwood. The noise is deafening; but you can run with ease in the rear of the herd, for they leave a track 200 yards wide, and beaten perfectly flat.

Where the water has stood for any length of time, the liquid mud left by it is quickly covered by an aquatic species of *Ipomœa*, with a pretty pink flower. This is the favourite food of both buffalo and waterbuck.

Near the hills, the marsh is covered with beautiful short grass of fine quality, clumps of the *Hyphæne* palm, and scattered dwarf trees of *Acacia*, with a few patches of a coarse rank grass that grows in tussocks—a favourite cover for lions. This grass grows from 10 to 12 ft. high in places. The whole country is one mass of white-ant hills. These are all single cones from 10 to 13 feet high, and are almost invariably bent over at the tips towards the north-west. It is difficult to account for this, unless it has something to do with the prevailing direction of the wind and monsoons.

On almost every ant-heap a vulture may be seen sitting at day break, waiting patiently for the white butcher to come and provide it with a meal, for the black man when he shoots a buffalo leaves very little for the vulture or anything else to eat. Climbing an ant-heap, and sitting on the top of it a wonderful sight meets the eye. Far to the left, a black line more than a mile in length, with a dense white cloud of egrets hovering in the air over it, proclaims a herd of buffalo. Another herd, a mile to the right, is lying down, covering an acre of ground with what appears to be heaps of jet black rocks; but here again the snowy white egrets, perched on the black bodies, betray their friends. Galloping about in squadrons, or peacefully grazing, are herds of zebra, whilst other herds of waterbuck are either feeding mixed up with the zebra, or walking in long lines over the bright green meadows. Long V-shaped flights of geese, flamingoes and pelicans fly from pool to pool. Not a sound disturbs this great plain, except the distant grunts and lowing of the buffalo, the snort of a waterbuck that has suddenly descried your native gun-bearer perched ape-like on an ant heap, or the far off moaning of a hungry lion disappointed of his prey.

Suddenly a puff of white smoke rises in the air, and the distant boom of a heavy gun rumbles over the marsh, followed by the sharp reports of Lee-Metford rifles—the great herds of buffalo are in instant commotion, and the firing becomes rapid and continuous. Clouds of dust arise as the buffalo gallop over the plain, followed by *sundry small specks*.—*nearer and nearer comes* the great herd at a slow lumbering gallop, till they thunder past, but the shooters are busy now killing the wounded and cripples. Vultures and Marabout cranes are now descending in thousands to devour the slain, whilst a dozen Manganja “boys” are cutting up a buffalo. The noble sportsmen (!) have butchered over twenty buffalo and wounded another score and are seated in the shade of yonder palm-tree discussing whiskies and sodas, and their morning’s exploits. A dozen motherless calves are wandering in the plain lowing for their lost parents—and will fall a prey to the first hyenas that see them, or die of starvation.

Walking back to camp, the bleaching skulls of buffalo and waterbuck are everywhere to be seen, attesting forcibly the

useless slaughter of the past. In Chiromo itself, piles of buffalo heads may be seen in every compound, either on the tops of ant-heaps, or wedged in the branches of trees, where the horns are speedily destroyed by borers. The slaughter of the buffalo is even worse when some globe-trotters appear on the scene, for they camp in the marsh for a fortnight at a time, and too cowardly to approach the buffalo close, fire at them from two or three hundred yards' distance with Lee-Metford rifles, wounding fifty times as many as they kill. I have heard over 150 shots fired of a morning in the marsh at buffalo and waterbuck before 10 a. m. Gunmakers now-a-days seem to cater for cowardly and lazy shooters, and it is impossible to take up the 'Field' without finding advertisements from half a dozen gunmakers who vie with one another in guaranteeing rifles for African sport to shoot from 400 to 1,500 yards with extreme accuracy. These gunmakers are the men who by supplying these long-range game rifles to all sorts of incompetent butchers, enable them to wound and destroy animals at half a mile distance, not one-tenth of which are ever brought to bag. Thus: two colonials from Natal were firing *every day* at buffalo in the Elephant marsh with Lee-Metford rifles for a fortnight, and the total number bagged by them was five! I was myself so disgusted with the tameness of the African buffalo in the Elephant marsh that after singling out and shooting four of the best bulls I could find—only one each day—I left the marsh and never returned to it, though it was only three miles from my head-quarters. I caught a splendid bull calf which I tried to rear with tinned milk unsuccessfully, but a *post mortem* revealed the fact that my rascally boys had so seriously injured it internally that it could not have lived. We were more successful with a cow calf which lived for some months. My intention was to have brought a pair of calves to India.

My next trip was to the tract of country south-east of the Shirè, and between that river and the Zambezi, but this I will reserve for the present.

R. M.

(To be continued.)

Too much Fire-protection in Burma.

At the present time there is a very marked tendency to advocate the enlargement of the fire-protected areas in Burma, and the idea is spreading that the fire-protection of all teak forests is a *sine quâ non* of successful management. Our department has fought the battle of protection and the money spent on this work has been well invested, for hitherto protection has generally followed plantation work, with this no Forest Officer could disagree. But we are growing more ambitious and now aspire to attempting sooner or later, the protection of all teak-bearing forests ; there

is even now a scheme on foot to protect the whole block of the Pegu Yomahs which may be said to contain the greater part of the teak forests of Lower Burma. The Government of India's Resolution on the Annual Report for 1894-95 is very strong on increased protection.

There is no doubt of the great benefit derived from the protection of our plantations in their early years ; we can prove it in many ways, but in what way can we prove that fire-protection extended to our ordinary teak forests is a benefit and not a curse ? It is the province of a Forest Officer to test new theories on experimental areas and to apply those which seem to stand the tests to larger areas. The system of protecting teak plantations has been tried, and the success gained warrants the protection of all such plantations in their early years, even at a cost greatly exceeding that of present operations.

The system has also been tested for ordinary teak forest—certain areas of forest lying between plantations and included in the same fire trace have been protected for years, but can any Forest Officer yet decide whether the protection has been beneficial or not ? A mere expression of opinion is not sufficient in a question of this importance, the benefit derived should be proved by figures, by ascertained and verified statistics, and it would then be for Forest Officers generally to determine whether the results were worth the expenditure. Until this has been done, I think we should give a verdict of "not proven" and deprecate any great increase in expenditure on *general* fire-protection.

We may take it for granted that our teak forests, or the greater part of those from which the best teak is extracted, are burnt over every year. For the information of those who do not know Burma, it may be as well to state that this fire in no way resembles the huge forest fires of America ; it is merely a ground fire slowly but surely advancing and consuming the dry leaves which cover the ground to a depth of a few inches or less. As a rule the flames are not more than a foot or so high and a pony will step over them ; in places of course there are patches of dry grass and *debris* where fire is often very fierce, but these are quite exceptional. A fire once started may burn for weeks and travel from one end of Burma to the other.

It is argued that because these annual fires are unnatural and owe their origin to human carelessness, therefore, by protecting the forests from fire, we are counteracting the evil and restoring to the forest its former condition of existence. I venture to disagree with this theory *in toto*. The very first settlers in Burma must have employed fire to clear their village sites, and these fires would spread as they do now from one end of the land to the other ; we may therefore presume that as long as man has inhabited the province, so long have the forests been annually burnt over ; to find the time when they were not subjected to the

ordeal we must go back to remote ages, and we have no evidence that the teak (as we now know it) existed or could have existed under the circumstances at that period. I think we may take it for granted that these annual fires, though originally perhaps due to accident, are now so constant and regular as to have become natural to the teak, destructive or harmful possibly at first. Nature by this time must have stepped in to fortify the teak against deterioration and to provide it with means to flourish under its altered condition; may not the thickened seed and the corky bark, both alike unaffected by the ordinary ground fire, have been gradually developed for this purpose?

Let us for a moment consider the effect of the ordinary fire:—

(a) At the time of the annual fires the teak seed has already fallen: as the fire passes over it, it is charred and blackened on the outside, but thanks to its hard exterior, its vitality is in no way impaired.

(b) The young teak seedling suffers considerably: in its infancy it is burnt down to the ground year after year, but the root remains undamaged, and at the commencement of the following rains the seedling shoots up again with yearly increasing vigour, the outside bark becoming more and more corky. At last comes a year when, owing perhaps to the fire being less severe than usual or to some other cause, the seedling is able to resist the fire; it is now established and has little to fear from the devouring element in the future. There is a general belief, however, that although the root may remain undamaged as regards its vitality, the actual wounds caused by the fire never really heal and are responsible for a great deal of the hollow timber we meet with in the forests.

(c) On the teak tree with its protecting outside layer of corky bark the fire has absolutely no effect.

(d) All other vegetation (with possibly one or two exceptions, though I can recall none) suffers very much more severely in its younger stages than the teak, and consequently the annual fire cannot be considered otherwise than as an agent favouring the growth of teak at the expense of all (or almost all) other species.

Though not yet conclusively proved, it is almost certain that the teak seed demands for its germination a good deal of light if not direct sun heat: by destroying leaves, low brushwood and seeds of vegetable species of more rapid germination than the teak seed, which would tend to shut out that light and heat, the fire doubtless assists the teak. To such an extent has the utility of fire in this way been recognised that many Forest Officers are of opinion that natural reproduction of teak over large areas, without the previous assistance of fire, is an impossibility.

Let us now consider one of our teak plantations and the effect of fire-protection. Previous to putting out the seed, all the existing vegetation is felled and burned; in the *taungyas* a

few tall trees are occasionally left, but all the low cover is most carefully destroyed; the seed is then sown in rows. This is more or less copying Nature, the difference being that more cover is destroyed, thereby reducing future expenditure in clearing the teak saplings, and also that the seed is placed in the most advantageous position. By fire tracing the plantation we preserve the seedlings from being burnt back, and in this way we not only remove one fruitful source of unsound timber, but we also reduce by some years the time taken by a seedling to reach maturity (in some of our working plans the rotation is calculated on a basis of allowing ten years for a seedling to establish itself, *i.e.*, to attain that size when it is no longer liable to be burnt back). But having shut out the fire which we have shown to be a natural means of destroying the teak's vegetable enemies, we must either see those enemies (quick growing when protected) smother the teak, or we must take steps to free our young seedlings by hand; this we have done, and large sums are annually spent on "weeding plantations."

We will suppose then that we have seen our plantation safely through its difficulties up to the age of immunity from ground fires; the question now arises as to whether we are justified in still spending money on protecting it from these fires. If we henceforth allow our plantation to be burnt over annually, we of course save the cost of protection; we also reduce the cost of subsequent "weedings" and this without any danger of causing direct damage to the saplings. But it may be argued that the fire acts detrimentally in an indirect way by destroying the *humus* and in baking up the soil. This I venture to assert is a purely theoretical damage. We are accustomed to see our oaks, our pines and our deodars all luxuriating in deep humus, and we jump to the conclusion that similar conditions should be provided for the teak, if we are to obtain the best results. Have we any evidence that our teak *wants* humus or even *likes* it? I will go further and ask if this humus may not be even baneful. The same may be said about the baking up of the soil, we find the teak growing under certain conditions, we are convinced that it has so grown for ages, and yet we seek to change those conditions without any proof that we are not thereby actually damaging the object of our care.

These fires do destroy every year a certain amount of more or less valuable material in the shape of logs and dead trees but with care and supervision this is preventible; on the other hand they do an immense amount of good by destroying decayed stumps and branches which in a fire-protected forest are sources of fungoid growth and the breeding grounds of so many insect pests.

In Burma where there may be only one underpaid Forest Guard to look after a hundred square miles of reserved

forest to say nothing of unreserved forest, it is hopeless to expect very much, but the practical application of the above would appear to lie, not in the general extension of fire-protection over hundreds of thousands of acres which cannot be watched in detail, but in the curtailment of existing fire lines so as to exclude the older plantations and in the protection of other small defined areas on which careful examination has revealed a fairly good stock of young seedlings. As the saplings on each area so protected reached the stage of immunity the protection would be stopped, and further areas operated on—the total area being limited by the number of seedlings and the amount of supervision available.

There is always a danger that remarks of this sort may be taken hold of by those who are not Forest Officers and strained to mean more than they were ever intended to convey. The abolition of fire-protection is not advocated, but its general extension to huge areas of forest irrespective of the state of the forest as regards natural regeneration is to be deprecated. I hold, until the contrary has been proved, that these annually recurring ground fires should be considered as the friends and not the natural enemies of the teak except during a certain period of its existence. Further, I hold that fire is one of the forest officer's most useful agents as long as it is his servant and not his master.

I am aware that these opinions are liable to be severely criticised, and I would ask those who do not agree with them to use the columns of the *Indian Forester* to ventilate their views on this important and interesting question.

LAKON; }
21st March 1896. }

H. S.

This article must be read as referring only to Burma, the remarks would not, we think, apply anywhere this side of the Bay. We hope some of our Burma readers will take up the gauntlet thrown down in the last para. and give their opinions, but we are bound to say that we disagree with our author in objecting to opinions, and requiring statistical proof. In Forestry, in our view, it is the mature opinion of experienced professional men that is more valuable than statistics.—
Hox. Ed.

The Compounds of Nitrogen contained in Hoar-frost.

In their researches into the composition of the atmosphere, MM. Petermann and Graftiau have noted the considerable amount of compounds of nitrogen contained in hoar-frost, and have drawn attention to the part played by this meteorological phenomenon in the formation of the stock of nitrogenous matter in forests, as also to the purifying action of wooded areas on atmospheric air.

"The hoar-frost deposited on branches presents to the air, which bathes it on all sides in a constantly renewed stream, a large surface of absorption for the soluble matters which it contains; isolated trees, plantations, forests, form immense filters, which purify the air passing through their branches and take from it its nitrogenous compounds, and these latter are carried down to the soil, when a thaw sets in, to feed the vegetation and once more enter the cycle of life. When we see the trees bending under the weight of hoar-frost and the branches almost breaking under the accumulated weight, we can easily understand that hoar-frost is an appreciable factor in the stock of nitrogenous matter collected in forests."

The following are analyses of hoar-frost collected at Gembloux and given in the above-mentioned work :—

Combined nitrogen per litre.					
Milligrammes.					
Water from hoar-frost of the 1st March 1889 ...					5.86
" " " " 2nd Jan. 1890 ...					7.70
" " " " 31st Dec. " ...					9.00
" " " " " " " ...					8.00
" " " " " " " ...					7.02
<hr/>					
Mean 7.52					

M. Graftiau made several experiments during the severe cold weather of last winter in order to discover the amount of hoar-frost that can attach itself to branches. Between nine and ten on the 7th February, with the thermometer at 168 C. below zero, the observer of the Agronomic Station of Gembloux collected hoar-frost on different species of shrubs growing in the park of the Agricultural Institute and obtained the following figures :—

	Weight of hoar-frost.	Weight of the branch.	Approximate surface of the branch.
<i>Cornus sanguinea</i> ...	2.0 grams.	2.0 grams.	30 Sq. centimetres.
<i>Populus alba</i> ...	2.8 "	3.6 "	30 " "
<i>Ribes saxatile</i> ...	5.5 "	52. "	100 " "
<i>Salix alba</i> ...	34.1 "	15.0 "	203 " "
<i>Salix vitellina</i> ...	39.3 "	32.1 "	270 " "

Mr. Graftiau also weighed the hoar-frost of a complete shrub (*Betula rotundifolia*). The cube of the surface bounded by the extremities of the branches being about 1.5 cubic metres the weight amounted to 1.755 kilogrammes and the hoar-frost contained per litre :—

				Milligrammes.
Ammonia	...	...	...	4.0
Nitric acid and nitrous acid	...	...	...	1.2
<hr/>				
Combined nitrogen				5.2

"The hoar-frost of the 7th February was not very abundant," says M. Graftiau, "and yet its weight exceeded one kilogramme per cubic metre of the space occupied by the branches. The branches in a high forest cover, at a low estimate, 100,000 cubic metres to the hectare ($2\frac{1}{2}$ acres) and can retain 100,000 kilogrammes of hoar-frost, which represents a supply of $\frac{1}{4}$ kilogramme of combined nitrogen, when we adopt as a basis for calculation the very slight amount of hoar-frost collected during the severe cold of the 7th February. Taking the mean figure of 7.5 milligrammes, this will come to 800 grammes."

"Hoar-frost is sometimes extraordinarily plentiful. It can on such occasions break by its weight branches of 10 centimetres in diameter. The amount of nitrogen that it then gives up to the soil on which it falls becomes considerable."

"If we add to that the nitrogen of rain, dew and fog, we can easily see how it is that, without any artificial supply of nitrogen and without considering the gain that may come from the presence of species that can fix nitrogen, forest vegetation can always find its nitrogenous food, and can see how wooded countries obtain this element from the detritus that falls in the forest."

As MM. Petermann and Graftiau say, the remarkable thickness of hoar-frost is one of the most interesting points in the complicated mechanism of the circulation and distribution of nitrogen throughout the world.

(*Révue des Eaux et Forêts*, from the *Journal d'Agriculture pratique*).

Torrent Barriers in Switzerland.

The *Révue des Eaux et Forêts* for March 10th quotes an article from a Swiss Forest periodical describing the successful, cheap, easy and ingenious method employed to prevent the ravining of the sides of Mount Pilatus, near Lucerne. Four different systems are used according to the depth and nature of the ravines to be negotiated. First, for small ravines, at most $1\frac{1}{2}$ metres in breadth, they put a single line of piles across the bed and tie them together with wattling (*clayonnages*). The piles form a curve, the lowest part being in the centre and standing half a metre above ground level. Taller piles are carried away, it is found. These structures are placed at distances varying according to the slope and the quantity of water to be dealt with. To start with, the lines of piles are fixed at considerable distances apart, and gradually intermediate lines are introduced. The piles require an occasional touch with the mallet, and it may even happen that a second line, just below, has to be introduced.

The second system is used for rather deep ravines of some two or three metres and consists in laying fascines in the direction of the stream, in rows of which each lies back somewhat from the

one immediately below, thus forming a slight slope downwards. The small ends of the fascines are uppermost. A row (or more) of piles, of which the heads form a curve across the ravine, the width being the lowest part of the curve, is driven laterally through the heap of fascines, and the whole is strengthened with cross poles, or staves fixed in between the heads of the piles. This obstruction must not be over 1.20 metres high, and if it is nearly this height, cross poles run into the side banks are required. In a very little time, gravel and mud become deposited and the obstruction is rendered perfectly strong.

The third system deals with very deep ravines down which much water may flow. The piles are driven into the bed, both across it and also longitudinally to some extent, being spaced at less than a metre apart, but it is not necessary to be too particular in spacing the piles, only they must rise to equal height above the stream bed, some three or four feet. Between the piles are put down branches, roots, stones and fascines in and out without order leaving the heads of the piles standing up some 20 or 30 centimetres and in a very little while the interstices become naturally filled up with mud and gravel.

The fourth system is more ambitious though still very simple. It deals with real torrent beds and consists of two lines of piles across the river bed, the upper standing and at most one metre above the soil, and the lower being driven right home. Between the lines a large number more are driven, but in such a way as to preserve an even face when the work is finished. Stones are forced in firmly between the piles right up to their heads. If suitable stones are not to be had, the piles are put closer, and may even be woven about with wattling before such stones as are to be had are put in. These systems of torrent obstruction are very cheap and require very little up-keep, and they are enormously strong.

It is perhaps not in many places in India that the forester is likely to be called on to negotiate torrents, but such a demand is by no means an improbability, especially when we consider the shaly nature of a great part of the Himalaya. The monsoon would tax one's best powers in this direction, we think.

Counting Yas in Burma.

The counting should be done in December after the rains, when sickly plants have had a chance of dying out, if they are going to. It is best to work with about five coolies, *i.e.*, a party of six, including self and the forester or guard. This number is easiest to manage, but, of course, there is nothing against using even 20 if you have the men well in hand. *On no account have the man who planted the yas as a counter, for if you did, should he get on a bad line, and the bad lines are known to him, he would be likely to say that less were dead and more alive than is really the case*

On arrival at the ya, the first thing to do, is to get each man supplied with a stock of sticks or what not, for marking each plant down as he arrives at it. In the Prome Division a very good marker is used, one too that is well adapted for use by a Burman. It is called a "gayo" and is made as follows, a piece of bamboo is taken 9 to 12 inches long, about 1 inch wide and $\frac{3}{8}$ inch thick, this is then first of all marked with a dah with parallel horizontal lines on the outside in multiples of 10, 20 being the common number. The piece of bamboo is then split up nearly to the end into narrow strips 10 to 15 in number (as in ii) each man takes five or six of these. It is customary for the planter of the ya to have these made ready for the counting party.

A day or two before commencing to count, the rows should be cleared for at least one foot on either side of the row. This is of great importance. *1stly.* As it gives the young seedling an impetus and more growth is put on. *2ndly.* It makes the counting ten times easier. All is now ready for the actual task of counting. The coolies are placed along one edge of the ya in order, each coolie taking one line down which he proceeds, as he comes to each plant he gives the strand of the gayo on the right a bend, if a blank or dead plant is found, he gives a bend on the extreme left strand. On arrival at the end of the line, the officer keeping the list takes down the results, beginning at number one, then two, and so on. He should particularly notice the total number in each line and the proportion of live to dead plants, and should there be any great difference in the lines, he himself should recount the line which differs. The end man on the inside ought at once to put a piece of twig or branch at the end of the line counted by him; so that in case of any confusion the last line counted is at once known, and it is easy to commence another series of lines without any chance of recounting, and thus getting a line in twice or of on the other hand missing out a line. The officer in charge should pay especial attention to this. Having finished one series of lines, the party proceeds back again in the opposite direction and counts another set of lines and so on until the ya is finished.

The form of 'gayo' above mentioned is very suitable, as for each complete strand the counter knows he has, say, 10 or 20 plants marked, and thus instead of having to count each bend, he has only to count the number of strands and multiply, the odd ones on the incomplete strand being added. When counting in the Zamayi (Pegu Division) in 1890, I found that the Karens used long "lines" (thin split strips of bamboo) sometimes 6 feet long. No divisions were made, and each bend had to be counted. This was a long and tedious work and errors were very liable to creep in.

The ya planter knows how many "panets" or sticks he put down when the ya was pegged out previous to planting, so that it is as well always to add up your list *in situ* and compare the total number dead and alive with the number of sticks which

the planter says he has put down. Should you find any startling difference, the ya ought to be recounted: by a startling difference, I mean an error of more than 5 per cent. in a compact ya or 10 per cent. in a straggling ya, or more plants than were said to be planted.

A deficiency is easily accounted for, as the outside plants often do not grow or again those in wet hollows.

An excess would at once lead you to suppose that the coolies had been favouring the planter and adding on, but with efficient supervision as you take the numbers down at the end of each line, such a contingency should never occur.

When checking, countings made by a ranger, it is sufficient to recount about 10 per cent. but these should be fairly scattered; and never take nice easy ones near a bungalow, as such are likely to be done well as the ranger expects them to be recounted.

You will never get the number exactly the same, but there should not be an error of more than 4 per cent. and the proportion of dead to alive should be just the same if counted soon after, but if counted some time after, and the weather has been dry, an error of about 8 per cent. may be allowed.

When checking the Divisional Officer should note whether the yas have been cut in places where teak and cutch are plentiful, if he finds such to be the case, he should reprimand or fine the guard and should not grant permission to the cutter to cut again.

If there are teak or cutch killed, they should be noted, so that it may be seen whether the guard has reported the fact.

All unreserved trees must be thoroughly killed, and if they are not, the ya cutter should be made to kill them before he is paid, and a small fine inflicted. It should also be noticed whether trees and bamboos cut are cut near the ground, and whether they are sending out stool shoots, if the latter, all should be cut before payment; if the former, a small fine inflicted, and a warning given to the planter that if trees are not cut close to the ground he will not have a license given to him another year.

If the lines have not been opened out properly and all bamboos near the edge cut, payment should be deferred until this is done.

At the time of counting, the compartment number should always be noted and the position of the ya marked on the map. The distance between the rows and the plants should also be checked.

F. J. BRANTHWAITE.

The Indian Forest Department and Coopers Hill.

The Inspector-General of Forests writes to us "With reference to an article in the *Indian Forester* for December 1895, I am directed to forward the enclosed communication from the Secretary of State for insertion in the *Indian Forester*."

We are very glad to print the correspondence sent us, and feel sure that it will be of great interest to our readers. Our own comments have already appeared at page 140 of our April number, and we have, in that number, explained that the orders of the Secretary of State of 1893 have never been inserted in the "Civil Service Regulations," so that we could not be expected to know of them. We certainly did not know of them, and we suspect that even in the Public Works Department they are not very generally known.

We have read Sir A. Godley's last paragraph with much satisfaction, and hope they will solve the question satisfactorily for us.

INDIA OFFICE ;
LONDON, 5th March 1896.

REVENUE No. 28.

TO HIS EXCELLENCY THE RIGHT HONOURABLE THE GOVERNOR-
GENERAL OF INDIA IN COUNCIL.

Forest Service ; Regulations for Examination of Candidates.

MY LORD,

I forward for your Excellency's information, copy of a letter from General Sir A. Taylor, and of the reply I have caused to be sent to him regarding the meaning and the accuracy of paragraph 17 of the Regulations for the Examination of Candidates for the Indian Forest Department.

I have the honour to be,

MY LORD,

Your Lordship's most obedient humble Servant,

(Sd.) GEORGE HAMILTON.

ENCLOSURES.

No. 1.

COOPERS HILL;
ENGLEFIELD GREEN, SURREY,
29th January 1896.

MY DEAR BERNARD,

Coopers Hill is being held to blame in connection with the idea that prevails, more or less, that the equality between Forest Officers and Officers of the Department of Public Works in the matter of pension, which in paragraph 17 of the Forest Prospectus is said to obtain, does not, as a matter of fact, exist.

I would urge that if there is the very faintest shadow of a doubt in regard to the "equality," it is altogether desirable that the statement in the Forest Prospectus should be omitted in future and cancelled in all copies that may be issued until a reprint occurs.

I send herewith a copy of the *Indian Forester* of December 1895, and would ask you to look at page 452 and 480, and then to have it returned to me at your leisure.

Sincerely yours,
ALEX. TAYLOR.

No. 2.

R. & S. No. 152.

INDIA OFFICE;
4th March 1896.

SIR,

I am directed to acknowledge the receipt of your letter addressed to Sir C. Bernard, dated the 29th January 1896, drawing attention to an article on pages 480-81 of the *Indian Forester* for December 1895, and suggesting that any doubts that may exist as to the pension for which Forest Officers are eligible, should be set at rest.

In paragraph 17 of the Forest Regulations, it is stated that the more favourable pension rules have been extended to Forest Officers appointed from England, who are thus on an equality with Public Works Officers appointed from Coopers Hill. The article in the *Indian Forester* points out that in the Public Works Department Chief Engineers are eligible for an additional pension of Rs. 2,000 a year, and Superintending Engineers are eligible for an additional pension of Rs. 1,000 a year; whereas a Forest Officer at the head of his Department is only eligible for an additional pension of Rs. 1,000 a year. And the article suggests that the Forest Regulations do not fairly state the conditions of the Forest service.

It is matter for regret that there should have been a misunderstanding, but the statements in the Forest Regulations appear to be strictly correct. The passage cited appeared for the first time in the Forest Regulations for the examination of 1894. At that time, the temporary concession, granted for special reasons, whereby Chief Engineers were eligible for an additional pension of Rs. 2,000 had been withdrawn by Lord Kimberley's despatch of the 21st September, 1893, which directed that "as regards those hereafter entering the service, whether in the Public Works, Telegraph, or any other branch, the maximum pension should in ordinary circumstances be Rs. 5,000 per annum. But in all the larger Depart-

ments * * * * I authorise you to grant an extra pension of Rs. 1,000 per annum, to any officer who shall have rendered not less than three years' approved service at the head of his Department in any province, and whose special merits you may consider 'to be deserving of such a concession.' From the end of 1893 these orders governed the award of pension to recruits thereafter entering from Coopers Hill College, either the Public Works, the Telegraph, or the Forest Department. The Forest Regulations for the examination of 1894 applied to recruits entering Coopers Hill College after that examination; and selected Forest candidates of 1894 and subsequent years will undoubtedly—so long as those orders stand—enjoy the same pension rules as their contemporaries of the Public Works Department.

It has not yet been settled how far a Conservator of Forests, belonging to the first or other grade, shall be treated as head of his Department. When that has been decided, the decision will be published in India, and will be embodied in the Civil Service Regulations.

I have, &c.,

A. GODLEY.

GENERAL SIR A. TAYLOR, G.C.B.

Turpentine from Pinus Khasya.

**LETTER FROM J. NISBET, ESQ., OFFICIATING CONSERVATOR
OF FORESTS, PEGU CIRCLE, RANGOON.**

As it may perhaps prove of interest to Forest Officers and others in various parts of India, I have the honour herewith to forward to you copy of a report kindly furnished by Messrs. Finlay, Fleming & Co., Rangoon, regarding the quality and market value of 30 tins of crude turpentine (resin?) from the *Pinus khasya* forests in the Eastern Circle of Upper Burma.

We have the honour to acknowledge receipt of your letter No. 2544-41-27, dated 9th instant, with reference to the 30 tins of crude turpentine made over to us in September 1894. We were under the impression that we had passed on to you the reports which our London firm obtained on this turpentine.

The following is from Mr. Boverton Rewood, one of the highest chemical authorities of the day :—

Dark coloured sample—Physical Characters semi-fluid, of grey colour, and having the usual odour of crude turpentine.

Results obtained on distillation.—On being distilled in a current of steam, the sample yielded 29 per cent. of oil of turpentine, leaving a residue of dark red rosin. The oil of turpentine had a specific gravity of '866 at 60° F., and a flashing point of 95° F. (close test).

Light coloured sample—Physical Characters. (Fluid somewhat viscid) nearly white in colour and with the usual odour of crude turpentine.

Results obtained on distillation.—On being distilled in a current of steam, the sample yielded 25 per cent. of oil of turpentine, leaving a residue of amber-coloured rosin. The oil of turpentine had a specific gravity of 868 at 60° F., and a flashing point of 95° F. (close test).

Results of further examination.—A sample of the oil of turpentine obtained by distillation in a current of steam was found to have a boiling point ranging from 310° to 360° F., and a specific rotatory power of $\times 32^{\circ} 36''$.

General Remarks.—Even the darker of the two samples yields oil of turpentine of good merchantable colour and odour, and the lighter sample gives a good rosin. The yield of oil of turpentine from both samples is satisfactory, both as regards quantity and quality. The oil of turpentine possesses the same characters as the product manufactured in the United States, having a dextro-rotatory action on a ray of plane polarised light and having a normal density and boiling point.

Judging from these results the oil of turpentine ought to answer all the purposes to which the American product is applied, but I would suggest that in the first instance a few barrels of it should be distilled and a practical trial of it made by converting it into varnishes.

The following is from a London firm of Brokers:—"If imported to this country in the crude state, the stills would have to be erected in an isolated position so as to avoid the risk of fire. To obtain the refined spirits of good colour, the stills would have to be of copper. One of the principal distillers of rosin here values your crude turpentine @ £4 to £5 per ton, and if he could obtain a constant supply at about this price, he would be willing to go to the expense of erecting plant to work it. This price is based on the present value of American Refined Spirits of Turpentine, £22 per ton. We may mention that during the last few years the price of this article has varied between £20 and £28 in London, and as the market has been going of late, we should consider £24 the highest figure that can be reasonably expected for some time to come. The value of the rosin obtained from our crude turpentine would be from £5 to £6 per ton in London."

The following is from a large firm of varnish manufacturers. 'We have carefully tested the two samples of Indian turpentine with the following results:—

	Dark quality.	Light quality.
Water	18.7	13.0
Spirit	21.3	24.5
Rosin	60.0	62.5
	<hr/> 100.0 <hr/>	<hr/> 100.0 <hr/>

The spirit appears to be about equal to Russian turps, and rosin about F grade. To work it, it would necessitate a special plant being laid down, our rosin stills not being suitable. We are willing to entertain the matter if we are guaranteed a certain supply per annum at a price not exceeding £4-10 per ton on our works."

It is evident from these reports that the turpentine is of good quality, but at the prices named, we fear it would not be possible to ship it at a profit to the London market.

It would certainly be out of the question to ship it in its crude form, to sell at £4-10 per ton—a price which would do little more than cover cost of packing and freight.

Taking the quotations given for the refined products, *viz.*, £24 per ton for spirits of turpentine, and say £5-10 for rosin, and allowing, say, 15 per cent. for moisture, the return would be about £9-6 per ton to cover first cost, cost of refining freight to London and sale expenses.

It you think it worth while, and will give us an idea of the probable quantity obtainable, we shall be glad to ascertain from our London friends the cost of refining plant.

A Novel Fishing Expedition in Burma.

Some time ago I accompanied a party of Burmans on a novel fishing expedition up one of our small rivers, and as the experience was a new one to me, as it will be probably to a great many of your readers, perhaps the *modus operandi* of landing the fish,

and an account of the day's sport will be of some interest.

A suitable spot is selected, generally a deep pool, where there is little or no current, and where the bed of the stream gradually shelves upwards towards the opposite bank. A long rope of nearly the width of the stream, and through the strands of which the newly developed white leaves of the toddy palm (*B. flabeliformis*) have been passed, is then weighted with boulders and laid down across the stream and at the edge of the pool. A bamboo raft about 10 ft. broad is then brought and placed exactly over this rope. A second rope, similar to the one above described, is then taken up stream for about a quarter of a mile in a boat by four or five men. This rope is then, after being weighted, let down on to the bed of the stream and has a long bamboo attached at each end and held by two men, and is gradually dragged along the bed of the stream towards the pool. The remainder of the men in the boat being armed with bamboos beat the surface of the water, throw stones and shout, and thus gradually drive the fish before them to the pool. On arriving at the pool, the second rope is fixed one end to bank and the other made to overlap the end of the first rope, thus forming a triangle with the bank as a base and enclosing the pool. And now the fun begins. The fish, finding themselves thus confined, swim about uneasily and try to jump over the raft, which being too broad for them to clear, they are at once secured by men stationed on the raft. The strange part of the thing is that the fish will on no account swim over the ropes lying on the bed of the stream. Two kinds of fish are found here, both scaleless, the *Nga-kyoung* or cat fish and the *Nga-bat*, and strange to say it is only the latter that tries to escape by leaping out of the water, the *Nga-kyoung* never by any chance makes the attempt. After the fish have quieted down a bit, the second part of the performance begins. This consists of men diving into the water and securing fish after fish by striking them with a huge hook about 18 in. long, the top bent and barbed like an ordinary fish hook. To the hook is attached a rope about 3 ft. in length, and the end secured to the wrist. When the men are ready, about four at a time dive under the water and swim about in different directions, and a fish coming within striking distance is immediately secured by a quick strike of the hook. As soon as the fish is fast on the hook, the man lets go of the hook and comes to the surface when the rope is released from his wrist and the fish secured. In this manner some 40 fish, varying from 10 to 40 lbs. were secured in a few hours by a party of ten men. The men on an average can keep under water for 25 seconds, and an old fellow who has been at it for some years, could prolong his stay to 35 seconds. It is only during the winter months when there has been no rain in the hills that this sport can be indulged in, as then the water is beautifully clear. The men pay Rs. 20 per annum for the right of fishing, but they do not sell what they catch,

merely catching enough for home consumption. The above is the only method by which these two fish can be secured here as *they will not take bait of any kind. There are Mahaseer also in the stream, but their scales are proof against the point of the hook.* There ought to be some good Mahaseer fishing in the higher reaches of the stream, and I hope to visit the grounds at some future date.

TAW-SEIK.

Louis Tassy.

The *Revue des Eaux et Forêts* of the 10th January has a long notice on the late M. Louis Tassy, Honorary Inspector-General of Forests, who lately died in his eightieth year at Aix-en-Provence, after a long (40 years) and very distinguished career in the Forest Service of France. His was evidently a most strenuous life, devoted altogether to duty, and although his character was a very amiable one, a good deal of controversy surged round his writings. These writings were a great feature of his life, for they were both numerous and finished. They seem to have been exclusively professional, and M. Tassy seems to have thrown himself into them with his whole soul. He forms a link with the early days of true systematic Forestry in France, for his day dates from that of Parade.

M. Tassy was born in 1816 at the place where he has just died, and the peculiar impressions made on him by his own beautiful land of Provence seem to have affected him all his life; as the writer of the obituary notice picturesquely puts it, M. Tassy's clear, orderly and harmonious spirit was like the bright, clear air of the land of his birth. M. Tassy had every chance for he came of cultured and estimable parents, the friends of famous persons.

Tassy joined the Nancy School in 1836, in the thirteenth promotion. The school was young then, but the spirit that was in it was an excellent one, and the Foresters of those days were full of hope and love of their grand profession—and these, we think often do more for a man than a highly systematic teaching. Parade became Director in 1838, and Parade inspired in Tassy a great and ever-growing admiration, which was reciprocated by the famous professor. With Parade too, was then associated the late M. Mathieu, known to so many of ourselves.

The warm heart of Tassy led him to form deep and lasting friendships at Nancy. Adolphe Lorentz, whom he met first there, was through life his great friend and helper.

The life after Nancy was a very varied one. It was passed, to begin with, at Sarreguemines and St. Laurent du Pont, but perhaps may really be considered to have begun in the forests of the Grande Chartreuse, under the distinguished M. Buffévent, who highly appreciated the young energetic Forester. In 1843, Tassy was sent to the Working Plans Branch, and took keenly to this work, as his writings on the subject shew. In 1846 he was called to the Central Secretariat, and in 1849 he went to Dijon.

Thereafter a great and novel field was opened to him, for he won the chair of Sylviculture at the new Agricultural College at Versailles, and was thereby enabled to extend to the public generally, or at least to the agricultural public—a knowledge of forestry. When we recollect the great extent of forest owned by private proprietors in France, we can realize how great an influence this meant. For this work, M. Tassy was by his breadth of mind and his powers as a lecturer thoroughly well fitted. Although this school was abolished in 1852, the effect of Tassy's teaching was still alive when the school was again started in 1876, when Tassy was once more appointed to his old post.

On the closure of the Versailles School, Tassy returned for a time to the Secretariat, but was in a few years, at the close of the Crimean War, called away to form one of a Commission sent to Turkey to see what could be done to utilize its natural resources. This work required a good deal of skill, but Tassy acquitted himself excellently, and was accorded the Legion of Honor in recognition.

He was recalled shortly afterwards and became for a time Conservator of Corsica (1862) but his heart was in his half-finished work in Turkey, and he returned thither in 1865.

From that date (1868) he worked vigorously with the assistance of four officers, four "Brigadiers" (Foresters) and some of his old Turkish pupils. We wonder how much of the goodly fabric thus raised still remains in that unspeakable land. For a time, however, it is clear Tassy's good work was appreciated, for the Ottoman Government tried hard to get him back again a few years later.

Thereafter Tassy became Conservator at Vesoul, and "Vérificateur-Général" of Working Plans, a post requiring much tact, which was amply shewn. It was *the* work for Tassy, and Tassy *the* man for it. The chief feature of it was the continuation of that big business, the conversion of coppice into High Forest, which has proceeded steadily now for a long time.

Then came (1872) special duty in Algeria, and on Tassy's report the system now in force there is founded. In 1875 he retired from the Forest Service.

In 1876, the Versailles School was again established and Tassy re-appointed. He remained in his old post till 1884 when he finally retired.

His chief writings are "Etudes sur l'aménagement des forêts," "Report on Algeria," and several pamphlets. He was one of the founders of the *Revue des Eaux et Forêts*. He wrote also vigorously on the subject of the reorganisation of the Forest Service, with which he had much to do in his last years of service.

Tassy passed the last nine years of his life in seclusion. He appears to have been a thorough Forester at heart, full of keenness and energy. Such men are the life blood of a Forest Service.

Remedies for Plant Diseases.

The following are some reliable formulæ for the treatment of fungi and insect pests. They have been taken from the Report of the Agricultural Experiment Station of the University of California, and are reprinted here for the benefit of the many inquirers in this country to whom the original reports are not, perhaps, accessible. It should be very constantly borne in mind that "Paris Green" and "London Purple" contain the powerful poison, arsenic, and should therefore be used with the greatest caution, especially in the case of plants, any part of which is used in the preparation of food or drink. The same caution applies, though with less emphasis, to "Bordeaux mixture," which contains an irritant copper salt.]

For powdery mildews use sulphur, dusting it on the plants.

For fungi in general use Bordeaux mixture, made as follows : For every 10 gallons take 1 pound of lime and 1 pound of bluestone. Dissolve these separately in hot water and mix when cool, adding the rest of the water. Spray on the plants. Or spray with ammoniacal copper carbonate solution, made as follows : Dissolve 1 ounce of copper carbonate in 6 ounces of ammonia and add 10 gallons of water.

For fungi and scale insects use lime, salt and sulphur mixture, a *winter* wash composed of lime 8 pounds, salt 3 pounds, and sulphur 4 pounds, for each 12 gallons of water. Mix one-fourth of the water, one-fourth of the lime, and all the sulphur and boil for one and-a-half hours ; put the salt with the rest of the lime and slake with hot water ; add to the above and boil half an hour longer ; add the remainder of the water and apply as a spray.

For scale insects use resin soap as follows : For 100 gallons for *summer* use take resin 18 pounds, caustic soda (98%) $3\frac{1}{2}$ pounds, and fish oil $2\frac{1}{2}$ pints ; for *winter* use, resin 30 pounds, caustic soda $6\frac{1}{2}$ pounds, and fish oil $4\frac{1}{2}$ pints. The material is put in a kettle and covered with four or five inches of water. The lid is put on and the mixture boiled two hours or more, and then the rest of the water is added, a little at a time. Spray

on the plants. Or use the gas treatment: Cover the plant with an oiled tent, and for each 100 cubic feet of contents place in a bowl beneath the tent $\frac{3}{4}$ ounce of water, $\frac{1}{4}$ ounce of sulphuric acid (oil of vitriol), and $\frac{1}{4}$ ounce of potassium cyanide (58%). Be careful not to inhale the poisonous gas, not to allow it to escape from the tent for half an hour. The leaves may be injured if used during the middle of the day.

For insects in general use kerosine emulsion, as follows: Make a soap solution of half a pound of soap to a gallon of water. Heat it to boiling and add two gallons of kerosine. Pump it through the spray pump, with good pressure, for five or ten minutes. For use add ten times as much water as you have of emulsion. Apply as a spray. Sour milk may be used instead of the soap solution. The emulsion is made more effective by the addition of a very small amount of arsenic to the soap solution, or of buhach to the kerosine.

For fruit or leaf-eating insects use Paris Green or London Purple as a powder at the rate of 1 to 5 pounds to the acre, distributed by walking or riding over the field, carrying a pole, at both ends of which are hung muslin bags containing the poison. As a spray use 1 pound to 200 gallons of water. In spraying these arsenites, the nozzle should be held at some distance from the plant and *no more should be applied after the leaves begin to drip*. Do not use these on crops where the poison would be injurious to health.—(*Indian Museum Notes, IV, 1.*)

The Forests of the United States.

The Secretary of the Interior has set on foot an investigation of the forestry problem which is sure to produce results of large interest and value, and which it may be reasonably hoped will lead to the adoption of a wise policy of forest administration by the United States. And whether this hope is destined to be realized or not, it is no more than just to say that Secretary Smith deserves hearty commendation for undertaking an important task in the right way. In response to his request the National Academy of Sciences has appointed a commission to study the subject in all its bearings and to make a report answering certain specific questions. The men selected for this work are admirably qualified to perform it. Indeed, they constitute an ideal commission. They are Professor Charles S. Sargent, Director of the Arnold Arboretum ; Mr. Alexander Agassiz, formerly Curator of the Natural History Museum at Harvard ; General Henry L. Abbot, of the Army Engineer Corps, retired, our leading authority on rivers ; Professor William H. Brewer, the eminent Yale botanist and agriculturist ; Mr. Arnold Hague, of the United States Geological Survey, and

Mr. Gifford Pinchot, who is in charge of the great undertaking in practical forestry which Mr. George Vanderbilt is conducting on his Southern estate, and who has perhaps had a more thorough training in forest cultivation than any other American. One needs only such knowledge as every intelligent person ought to possess of what these men have done in their several fields of activity to realize the advantage which the country may derive from their co-operation in the inquiry which Secretary Smith has instituted.

The commission is asked to determine whether it is desirable and practicable to preserve from fire and to maintain permanently as forested lands those portions of the public domain now bearing wood growth for the supply of timber; how far the influence of forest upon climatic soil and water conditions makes desirable a policy of forest conservation in regions where the public domain is principally situated; and what specific legislation should be enacted to remedy the evils now confessedly existing. It will be seen that the whole case is included under these three heads. The commission will probably be expected to answer the first question broadly in the affirmative, and to report in favor of a National policy of protecting the wooded domain of the United States; and there is every reason to trust its sagacity for a safe guide toward practical legislation. The investigation is proposed at an opportune moment, inasmuch as the Commissioner of the Land Office has apparently been induced to approve the plan of stripping the great Cascade forest reservation of Oregon, and the whole Sierra preserve is in danger. It is a cause for deep gratitude that experts whose disinterestedness is as complete as their scientific equipment have consented to perform so necessary a task.

There is no need to say again that the forest wealth of the United States has been lamentably wasted, and that we are already suffering seriously from conditions which must inevitably grow worse so long as they are neglected. At the same time it is not strange that this state of things should have come to pass. Even observers of superior intelligence have only recently begun to realize that the vast forest endowment of the country was not inexhaustible. It naturally seemed so to many successive generations. The woods not only appeared to early settlers, and to the host that was for ever migrating westward, to be an obstacle which must be removed, but actually to a great extent were just that. A clearing was the first requisite for immediate comfort and material advancement. Whoever cut down a tree was regarded as a pioneer of civilisation and a public benefactor. To this day, it must be acknowledged, though an understanding of the truth has developed rapidly of late, there is widespread indifference to the proofs of enormous losses already sustained even in the State of New York, where an active propaganda for the preservation of what is left of the North Woods has been going on for many years.

Of course selfish interest is usually able to make a winning fight when a majority are not aware of what the common welfare demands, or sluggish in the defence of their rights. But it cannot be doubted that the people of the United States will comprehend, sooner or later, the magnitude of the sacrifice which they have encouraged and the disaster which they have invited. That day of general knowledge and of consequent determination to rescue and save the fragments of a superb National possession may be hastened by the commission just called into existence. We earnestly hope that this will be a chief consequence of its labours, and it is reasonable to believe, though the leaven may continue to work slowly among the masses of the people, that this investigation will stimulate the intelligence and conscience of the Government and so bring about the adoption of a sagacious forest policy. —(*New York Daily Tribune*).

Colonial Timbers for Wine-Casks.

I draw attention, in a tentative way, to the subject of indigenous timbers for cask (and particularly wine-cask) making. The subject is not free from difficulty, for in Europe the best woods for casks have only been found out as the result of many experiments and long experience. Ours is a new country, and we cannot gain experience in a moment ; moreover, money is not sufficiently plentiful to enable one to risk the quality of a large quantity of wine in trying experiments on many timbers. But with our admittedly wonderful variety of native timbers, it would be a most extraordinary thing if we have not among them some timbers which satisfy all the desiderata of a good wine-cask. I would go further, and say that such a thing must be impossible. So much being premised, we want to find the best timbers for the purpose. I proceed to give a few notes in regard to timbers most of which have been more or less tested for wine-cask making. I hope it may be suggestive, and that it may result in the Department being furnished with hints on the subject by vigneron, coopers and others. The Department is only too anxious to aid the important wine industry of the Colony, in helping those engaged in it in regard to this very important question. There ought to be no insuperable difficulty in having small casks made of various woods, and wine placed in such casks, to be examined by experts in the subject.

Mr. Hubert de Castella, the well-known Victorian vigneron, in giving evidence before the Vegetable Products Commission of that Colony states, "I do not think lightwood is a very good wood for casks ; it give a slight taste ; I tried lightwood ; I had thirteen large casks made from lightwood, and we exchanged them for oak. Even after a year or two, and wine had been in it, we thought it gave a slight taste to the wine—an oily taste."

Subsequently, Mr. de Castella said, "On a former occasion I made a few remarks on casks, a subject which is of the greatest importance to the wine industry of this country. I was in hopes that this might have provoked some discussion, but in this I have been disappointed; and now again I venture to urge the importance of the matter.....I have used blackwood since 1863, and found it in every respect equal to oak. By blackwood I do not mean what is often supposed to be the same, namely lightwood, which is utterly unsuitable for wine, though good enough for tallow Mr. Ransome, one of the judges of Australian timbers at the last London Exhibition, recommended mountain ash as suitable for cooperage; and I have been told that this wood is largely used at Albury. There again a vast difference must be made in favour of what is called blackbutt, which is quite different timber from the mountain ash, as between blackwood and lightwood..... When I first began to make the casks, oak was the only timber supposed to be used. There was not a plank of oak in all the Colonies. Mr. Higginbotham was making railway carriages and he said 'Why not use blackwood, as we do in the Railway-works?' and I got a couple of planks and made a cask of 130 gallons, and I made big casks, 1,500-gallon casks, and it is an excellent wood. And then the mountain ash has to be tried. There is some prejudice against those things. In England some people say they will not have the wine in any cask except Baltic oak I asked, when I was buying staves, whether there was any difference between blackwood and lightwood, and the timber-merchant showed me that if you cross-cut the wood, the blackwood is as hard as horn, and the lightwood porous. As the cooper puts his mouth to it his breath comes through. The one is useless for wine and the other is excellent, but the coopers do not know that generally."

As regards the blackwood and the lightwood of which Mr. de Castella speaks, I would invite my readers to the article on blackwood in the *Gazette* for March, page 129, where the subject is discussed, so that I need not repeat myself here.

Speaking of mountain ash, Mr. H. de Castella says, "I have tried to put new wine in mountain ash, which is a very good wood; it has not given any taste to the wine except those casks being made by a cooper who bent the staves with fire, the mountain ash, from being charcoaled a little inside, gave a slight taste."

Mr. de Castella speaks highly of mountain ash, and even more highly of blackbutt. Now the mountain ash is probably that very tall Victorian tree which is botanically ranked under *Eucalyptus amygdalina*. This is best known as an oil-yielding species; but it may be *Eucalyptus Sieberiana*, which is well known in New South Wales as a mountain ash. It has a bark which at a little distance may be mistaken for an ironbark, but the branches are, unlike those of ironbarks, perfectly smooth. It is common

in cold mountain regions, chiefly in the southern coastal districts. Whether this is the mountain ash referred to by Mr. de Castella or not, it is a grand timber, pale coloured, an excellent splitter, and a sound, durable, strong timber. I would strongly recommend that it be given a thorough trial for wine-cask making.

Again, it may be a mountain ash sometimes known as white ash which is found in the highest mountain ranges in the direction of Candelo to Kiandra, and the extreme southern portion of the Colony generally. This is a beautifully clear, straight-grained, white timber, which is at present brought to Sydney in small quantities as a substitute for American ash, and it is used to some extent for bed-room furniture. At present it costs a good deal for carriage, but it is a first-class timber and is, I should think, likely to be eminently suitable for wine casks. If the matter be inquired into, I have no doubt we shall find this timber in more accessible localities.

As regards the blackbutt, if Mr. de Castella is reported aright it must be our old Sydney friend *Eucalyptus pilularis*. But if you want to see really fine blackbutts go to Termeil, between Ulladulla and Bateman's Bay, and other localities on the South Coast. There you will find very giants, both as regards height and girth, and they will split as straight and as true as good stringybark.

But, to return to Mr. de Castella's evidence, it is not perfectly clear, because of the use of vernacular names. I have shown that there are various mountain ashes and when he speaks of blackbutt, it is quite possible that he is speaking of a very black-butt mountain ash, such as *Eucalyptus Sieberiana*, in comparison with the smooth barked mountain ash known to botanists as *Eucalyptus amygdalina*. When the use of vernacular names (particularly in regard to *Eucalypts*), causes a feeling of uncertainty as to the timber referred to, is it a wonder that botanists look forward to the millennium, when everybody will use botanical terms for the purpose of designating timbers, because the advantages of their use are so evident? That botanical names are hard to get hold of is a popular error as erroneous as it is widespread.

Mr. William Graham, also giving evidence before the Victorian Royal Commission of Vegetable Products, says:—"The native woods seem to be very good for wine casks, but we have not tried them to any extent. I think blackwood is the best colonial wood for casks. Mountain ash has been used, and has been fairly successful, but not to any great extent. Casks from Tasmanian silver wattle look very well."

It will be observed that both Mr. de Castella and Mr. Graham appear to think that blackwood is the best colonial timber for wine casks. Small blame to them, for they are Victorians, addressing a Victorian Royal Commission, and blackwood is a common timber far better known in Victoria than in this Colony. We have a far better assortment of timbers than

our good friends over the Murray, and surely we do not lack the enterprise necessary for taking advantage of our good fortune.

Mr. Graham cautiously refers to casks of Tasmanian "Silver Wattle" as *looking* very well. I am afraid we want something else in wine-casks than good looks; but if anyone in New South Wales wishes to try silver wattle we have plenty of it. Its botanical name is *Acacia dealbata*. Other New South Wales wattles I would like to draw attention to in this connection are the black wattle with broad, two-veined leaves (phyllodia), whose botanical name is *Acacia binervata*. It is plentiful in the coast districts, grows to a large size, and the mature wood is dense. Then we have the mountain hickory, which is abundant in the mountainous districts of the South. It attains a large size and its timber is an excellent substitute for the true blackwood. Its botanical name is *Acacia penninervis*. Then I would doubtfully suggest the brigalow (*Acacia harpophylla*) of which a good deal is to be found in the Narrabri District. It is a dense, valuable timber and might be tested by the wine-growers along the Northern line of railway.

Perhaps the New South Wales timber which has been spoken of more than any other for wine-casks is the silky oak (*Grevillea robusta*), which grows in northern brush forests. At one time it was far more extensively used for tallow-casks than it is now, but a number of experiments have been made with the view to give it the more dignified employment of wine-storage. Mr. Thomas Hardy of South Australia placed shavings of this wood in light wines for two months without affecting the taste and colour of the latter. He pronounced the wood suitable in other respects; and therefore suitable for casking wine. The opinion of an authority so eminent must carry great weight, and I am therefore surprised that I have not heard of the matter being followed up during the last three or four years. Silky oak would not leak when split on the quarter, and Mr. Hardy has been instituting inquiries as to whether the staves would leak when the wood was cut across the grain. I have not heard the result of these inquiries. Mr. Charles Moore, Director of the Botanic Gardens, pronounces silky oak too porous to hold such liquids as spirits.

Now that *Grevillea robusta* is getting scarce, I would like to draw public attention to what I believe to be a perfect substitute for it. The commonest tree in the Dorrigo Forest Reserve is one known to botanists as *Orites excelsa*, and its wood usually passes as silky oak. I examined the timber carefully in the forest, and brought a few pieces to Sydney. Everybody I have shown them to pronounces them to be silky oak. At the present time, if there is any difference between this *Orites excelsa* timber and that of *Grevillea robusta*, I do not know what it is, and it is evidently not of a superficial character. I was pleased to make this discovery, as there is a perfect mine of this silky oak in the

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Dorrigo. There are millions upon millions of feet of it, and at present not a stick is used. But even if it be not used for wine-casks, the time will come when it will be used for butter or tallow-casks, or for some other humbler yet useful purpose.

I desire now to draw attention to a timber for wine-casks which I had not thought of for the purpose until Mr. Thomas Bawden, of Grafton, kindly brought it under my notice. His remarks on such a subject demand respect, for, as is well known, he has given a good deal of attention to the utilisation of our native products during the last thirty years and more. Mr. Bawden says: "With regard to wine-casks, and the proper wood for the purpose, I think you will find rosewood the very best. I know some years ago the late Richard Bligh had some large vats and casks made of that timber, which suited admirably, and certainly gave no taste to the wine. I yesterday asked an old wine-grower of large experience what he thought best for wine-vats or casks, and he at once selected rosewood, as giving no taste of a deleterious character to the wine. He has tried silky oak, but has condemned it, and has not been able to get anything better than rosewood. I replied expressing doubt whether an odorous wood, of the nature of rosewood, would not affect the bouquet of wines stored in it. In a recent letter Mr. Bawden writes: "With regard to the rosewood for casks, I have the assurance, in addition to my own large experience, of one who has been engaged in wine-making in this district for the past thirty years, that the wood does not give any taste to the wine. Might I suggest an experiment of a small piece of seasoned rosewood placed in a bottle of wine for a few months? Should the rosewood turn out as I believe it will, there are large quantities of it in this district." I venture to express the hope that those who have tried rosewood for wine-casks will relate their experience, and that those will test it who have facilities for so doing and have not yet done so. It is high time that such an important matter were settled. The botanical name of the rosewood referred to is *Dysoxylon Fraserianum*, and I should also like to see exhaustive tests made of the red bean (*D. Muelleri*) which may be described as a scentless rosewood. Who will take the matter up? In the Dorrigo Forest Reserve (not to mention other northern forests) there is an enormous quantity of mature rosewood, and at the present time an axe is never put in it. Just now things are so bad with the unfortunate timber getters, that rosewood may be had at a very low rate. It behoves patriotic people to do their level best to encourage the use of colonial timbers. At present a timber is looked askance at, in many quarters, simply because it is colonial. But this should not be. Surely an educated public is discriminating enough to know a good timber and value it on its merits.

This article is already of sufficient length, and I will therefore content myself by alluding to only one more timber. I have heard native beech (*Gmelina Leichhardtii*) spoken of in the highest terms as an excellent timber for wine-vats. Is there any drawback to its use? If so, what is it?

And if all these timbers I have mentioned be found unsuitable for wine-casks, I will mention some more, for if public spirited men can be found to thoroughly test the timbers, I am determined that they shall not lack likely woods to experiment upon.—(*J. H. Maiden, in Agricultural Gazette, N. S. W.*)

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The Forests and Fauna of British Central Africa.
(Part II).

In May and June I went through a serious illness and was advised to leave the country, but I had no notion of abandoning a trip that had cost me so much trouble and expense, so I determined to get up to the top of Milanji mountain and there recruit my health. I only had my twelve Manganja boys, and found it impossible to get a set of bearers to carry me up in a machilla, so had to trudge the journey on foot, a distance of some 80 miles. Accordingly, I made a start at the latter end of June. The path led along the banks of the Ruu River; after leaving Chiromo we passed through an extensive grove of *Hyphæne* palms, then through numerous patches of Manganja cultivation. The water in the Ruu was beautifully clear and shoals of large fish were distinctly visible in every pool. The mealie gardens on the banks of the stream had been considerably ravaged by Hippopotami. The forests on the Portugese side of Ruu, were considerably finer than any I had seen yet, consisting as they did principally of the "masetu" already mentioned. I had managed to walk fourteen miles by sunset and having outstripped my boys, waited under a big tree for them to come up. The guinea fowl were flying down to roost on the large trees on the river's bank, so I sent one of my Indian boys back and got my shot gun, and killed a couple for the pot.

The men were so heavily laden, that it was 8 p. m. before the last of them straggled in. The spot where we had camped had been a large village of Malolo's, but had been recently burnt down, and Malolo expelled. He was camped on the opposite side of the Ruu. At daybreak we resumed our march through more abandoned villages, and after travelling about four miles, began ascending the hills. Hitherto the path had followed the bed of the Ruu, which, for the last ten miles, had become rocky and broken. After climbing up about 1,500 feet we entered a broken and hilly country precisely similar to some parts of the Wynaad. Very few

of the trees exceeded 18 inches in diameter, the ground underneath being covered with a dense growth of grass, from four to ten feet high, the bark Cloth trees here (an *Acacia*-like tree with the usual pinnated leaves resembling *Albizia Lebbek*) were the principal feature in the landscape. I searched for seed but could find none as the pods were still green.

For some six miles the path led up and down steep hills, till we finally emerged on a clearing. This was a coffee estate belonging to Mr. Buchanan. We walked through the estate and sat down under a tree to wait for the baggage to come up. It was then about 2 P. M., so I amused myself walking through the coffee, and examining the growth of the trees. Such of them as were alive looked healthy enough and were fairly well grown, but there was an immense proportion of gaps, and a still greater number of trees, either dead or dying. A careful examination showed that two species of Longicorn beetle had been at work on them. One species had girdled the trees, and thus killed them. The larvæ of the other had attacked the roots in numbers, boring tunnels to the very end of each of the main roots. I obtained specimens of both beetles and found the first species exactly similar to the one that girdles coffee trees in India. As a rule, this beetle only lays one egg, and the larva bores either up or down the pith of the stems. The second mentioned species, which is less than half the size of the other, appears to lay numerous eggs.

The men turned up about 3 P. M. and absolutely refused to travel any further, so we camped for the night on the banks of the river. A Yao came to my camp in the evening, and offered to show me a Hippo pool, if I would give him the modest sum of Rs. 10. It rained during the night, and my boys had a miserable time of it, for though I had warned them that rain was coming and advised them to put up a grass hut for themselves they were too lazy to do so, and suffered the consequences. At day-break, an immense flock of guinea fowl came down to the rocks on the opposite bank of the river, and began preening their feathers, but the river was deep, and there was no way of crossing, for the crocodiles were floating about everywhere. Whilst watching the guinea fowl, there was a great commotion amongst them, and loud screeching and cackling, as they flew up into the trees; and presently a large panther appeared sneaking amongst the rocks. I tried to get a shot at him with my Lee-Metford, but did not get a fair chance.

We started about 7-30, for my tent was wet, and I had to light a fire in it and dry it. After travelling over a much more level country for about 12 miles, we met another Yao villager who promised to show us any number of Hippo in a pool in the river about a mile from the road, and implored us to shoot them as they were doing much damage to the cultivation. As I felt weak and exhausted, I went to the pool and camped under a large

tree. There were many old signs of Hippo about, but not one did we see and this was accounted for next morning by some villagers who came over from the opposite village in a bark canoe and told us that some "Mazungoos" (white men) had come from a coffee estate a few days previously, and had fired at, and driven the Hippos away.

I amused myself fishing in the evening and caught some carp, very similar to the *Barbus carnaticus* of India, but with a golden tinge on the sides. There were some fine perch of some two or three lbs in weight, but I only succeeded in getting one of these gentry, with a mole cricket as a bait.

The next morning after travelling about half a mile I came to Mr. Simpson's Inchila estate where he very kindly asked me to stay. I was much disgusted with my boys for not letting me know about this, for I would have had a more comfortable time of it in the hut; the Inchila river had to be crossed by wading, after this, and very cold I found the water. A good bridle road from this point made travelling very much easier. We passed through country that had been heavily 'Koomried.' In many places the forest had not been able to re-assert itself, and large patches were entirely covered with high grass. The country was slightly undulating, with small streams in the hollows. Numerous patches of 'Masuko' trees were seen. This tree yields one of the best edible wild fruits of Central Africa. Owing to the trees having been 'Koomried' they consisted chiefly of straight poles, the leaves somewhat resembling those of the *Semecarpus* or * Marking-nut tree; the fruit is about the size of a loquat with a leathery pinkish brown skin. I did not succeed in securing any of the seed, but got some young plants. I found some custard apples growing in old 'Koomrie' land, my boys called it the 'Imposa' and declared the fruit to be excellent eating; I secured some plants. The profusion of wild flowers was delightful, and I obtained the seeds and plants of many species. There were no less than three species of cowhage, † one bearing beautiful bunches of creamy white flowers, the other two species were somewhat similar to the common Indian ones. I found the hairy pods the greatest curse in travelling subsequently, and was driven out of one or two camps by the fine hairs being blown by the wind into my tent.

That night we camped once more on the banks of the Ruu, and the next day, after a longish march, reached Mr. Simpson's Tundialema estate, at an elevation of about 3,000 feet, on the slopes of the Milanji range. The last 1,000 feet was a sheer pull up the mountain side and took it most completely out of us. Here I put up in a small brick-built house, belonging to Mr. Simpson, who very kindly placed it at my disposal.

* *Semecarpus Anacardium*; † *Mucuna pruriens*.

Unfortunately for me that gentleman was absent in Chiromo. After a couple of days' rest, I decided in getting up to the top of the mountain, but my boys had other ideas on the subject; labour was very scarce, and the few men Mr. Simpson had were urgently wanted for estate work. However, as my boys were bound to serve me by stamped agreement, I insisted upon their going up, promising, however, not to keep them there, but to send them back directly.

Upon this, they made a clean bolt of it, so I sent one of Mr. Simpson's men after them, to tell them that I was writing to the Collector at Chiromo, who would severely punish them for breach of engagement; this brought them to their senses, and we succeeded in making a start finally.

A few hundred yards from Mr. Simpson's house, we entered a veritable shola, with lofty trees, and magnificent bamboos. Balsams and orchids grew on every rock and cranny, and a beautiful clear stream of water, icy cold, tumbled over moss-grown rocks. After passing through the shola we emerged on sheet rock, and after that, the climbing became extremely difficult for me in my then weak state. As we mounted higher and higher, I found many strange and new wild flowers, beautiful aloes, with salmon coloured and red flowers, growing out of the crannies of the rocks. A small proteaceous tree was remarkable for its large white flowers, it might have been mistaken, in the distance, for a *Rhododendron*, and reminded me of the 'Warratab' flowers of Australia, which I saw growing on the hills near Sydney. Wild heaths, ten and fifteen feet in height, were abundant, but the flowers were small and inconspicuous.

About 4 P. M. I struggled to the top, and rested on a slab of rock, admiring the fine prospect spread beneath my feet, the view was very similar to what may be seen at Pykara or Naduvatam, where one gazes over the interminable forests of Wynaad and Mysore. Nothing disturbed the silence and solitude of the spot but the harsh croaking of four or five pied African ravens that inquisitively peered at me from the crags around. After an hour or so my boys came panting up the hill with my leather cowrie boxes, and a half mile walk over a grassy down led us to Mr. Simpson's hut built on the banks of a small stream.

A bitterly keen southerly wind had commenced to blow, so my boys lost no time in hurrying down the hill again, leaving me and my two Indian servants to shift as best we could; we had also two Mangauja boys, whom I provided with warm woollen clothing. The night was bitterly cold, and I got no sleep, the keen wind came in through the cracks and crannies of the wattle and daub walls. I had lit a fire on the floor of the room, but the smoke very soon drove me out of the improvised bamboo cot which Simpson had put up, so I had to spend the night cowering over the fire. The four succeeding

nights were spent in much the same manner. At early dawn I made myself a cup of cocoa and started off with my Lee-Metford to climb the high hill behind the camp. The whole country was covered with hoar frost in the valleys, and when this melted, and my boots got wet it was decidedly unpleasant. From the top of the hill I looked over a great valley lying at my feet, down which a stream flowed, the head waters of the Ruo. Looking south-eastwards there was a great gorge covered with heavy shola. At the head of the stream, another valley branched up the centre of the range, and its lower portion was clothed with that magnificent tree, the Milanji cedar. There was a considerable wood too to my left and a smaller still further north, full of these cedar trees, while numerous small sholas exactly like those on the Koondah mountains were scattered about in the minor valleys and slopes.

Of animal life there seemed to be but little, with the exception of wild pigs, which had made numerous narrow pathways in every direction. After breakfast I took a small 28 bore gun and the Lee-Metford, and went on a botanizing expedition into the sholas. Birds were very scarce, but I managed to shoot a beautiful Turaco, or plantain-eater, a lovely grass-green bird, shape somewhat like a magpie, with lake-coloured patches on the wings. These birds were exceedingly noisy, and anything but musical, for they made the woods resound again with their harsh notes. No sooner had a small party of these birds uttered their discordant cries, than every Turaco within hearing joined in the chorus. I here obtained a beautiful sun bird, sage green above, with a canary-coloured breast and a beautiful scarlet band round the throat, the top of the head being capped with metallic green. We also flushed a ground dove in a small wood, which after considerable trouble I succeeded in bagging. It was of a beautiful bluish slate colour, paling into ash about the neck, doubtless a *Chalcophaps*. Some large bluish-coloured wood pigeons were also seen flying from wood to wood, but they never gave me the chance of a shot. We came upon traces of a large cane rat, and heard it calling, also saw in two places amongst the rocks about a bushel of hares' buttons but never saw the animals themselves. I picked up the jaw bone of what appeared to be a rodent from the molars, but the extraordinary thing was, that the sockets of two well developed canines, which had fallen out, appeared in the jaw. I secured an extraordinary rodent covered with the most beautifully soft and silky fur, with minute eyes no bigger than a pin's head, this animal had only the vestige of a tail, about $\frac{1}{4}$ of an inch long. This strange creature I kept for three or four days, when it made its escape. My boys called it "Nyamtuka." The first discovery I made was a fine species of bamboo growing at an elevation of about 8,000 feet inside the sholas. I succeeded in obtaining four off-shoots. This fine Bamboo grows to a

height of 50 or 60 feet, with a diameter of $3\frac{1}{2}$ inches. It is thornless, and struck me as being the very thing I had so long wanted to introduce on the Nilgiris, namely, a useful species of large Bamboo.

The next day I devoted entirely to the collection of seeds and bulbs and other botanical treasures, getting many specimens of new Gladioli, ground orchids, aloes, orchids, etc. I managed to bribe some of my boys to climb some Widdringtonias,* and spent three days thus collecting seed, but found it very unsatisfactory work, the cones being scarce, scattered far apart in the branches, and mostly immature. However, I got a few ounces of clear seed in all.

I had sent my boys away to Lake Chirwa, some 60 miles distant, to obtain fowls and eggs, as none were procurable nearer; they fortunately turned up on the fifth day. That evening, I felt great pain in my knees, and foreseeing that I was in for one of my usual bad attacks of rheumatism, I returned the next morning to Mr. Simpson's estate. There I was laid up for the greater part of the month with a severe attack of rheumatism. As soon as I was well enough to be carried in a machilla, I started for Zomba, as the Commissioner had kindly invited me to go there, but owing to the cold which made my rheumatism worse, I was compelled to return six days afterwards to Mr. Simpson's estate, without ever having got to Zomba. Mr. Simpson having returned, kindly provided me with some Atonga carriers, and both my servant and myself were carried down to Chiromo, the legs of the former having so swelled that he was unable to walk. I met with no adventures on the road, with the exception of shooting a big bull Hippo at the "Tuchila estate," which came in as a godsend for my men and the villagers.

The Tuchila plain, though a magnificent game country in former times, is now almost destitute of game, and during the time that I was in the Milanji district, both my men and myself had to undergo a considerable course of starvation; the only thing I shot was one guinea fowl during the month I was there; eggs and chickens were almost impossible to obtain, the people were poverty-stricken, and had nothing to barter with us except sweet potatoes.

After remaining some time at Chiromo to recruit my health, I started westwards to explore the country between the Shiré and Zambesi rivers, as my boys gave me a glowing description of it and the amount of game there. We accordingly started one morning in a southerly direction, and camped near a village some four miles from the foot of the hills. The next day our path lay amongst numerous stony hills covered with ebony and acacia trees, but stunted in growth. About mid-day we crossed the hills and descended into Portugese territory, the boundary line running along the water-shed at an elevation of about 1,500 feet

* W. Whytel.

above the sea. About 3 P. M. we reached a small village where we camped. The appearance of the country was not attractive so far as prospects of game were concerned. There was no water except a small stagnant pool near the village, and no signs of game about whatsoever. I travelled altogether eight days in this country without firing a shot, and without seeing any game except one small herd of Zebra. The population seemed to be considerable. I passed numerous villages the owners of which paid tax to nobody. Some of the women and children had never seen a white man before. As the grass was being burnt everywhere and the country very rocky and stony, I determined to push farther north where the hills rose to a considerably higher elevation, and running water might be expected. We finally got into this country and I had some good sport. The character of the forest was pretty much the same everywhere, the trees were from thirty or forty feet in height on the slopes of the hills, and at that time of the year, were quite leafless. The young grass was beginning to spring up wherever it had been burnt, and game, though fairly abundant, was extremely difficult to approach, owing to the open nature of the forests and the smallness of the trees, and there being no undergrowth of any description whatever. I only came across two "Masetus," they were of considerable extent, and very difficult to penetrate. I entered one and after following Rhino pathways for some time, finally got lost in it, and it took me six hours' very hard work to get out again. Baobabs and acacias were the prevailing trees, but there were numerous Euphorbias with very umbrageous heads, scattered about everywhere, and the edges of the Masetus were thickly covered with wild coffee in full blossom.

I found this coffee very abundant on the banks of the 'Ruoi' in May; and collected some of the seed which I sent to India. The seed of this species of coffee is reddish yellow, extremely small and perfectly worthless as an article of commerce.

I found the wild coffee of the Mozambique province cultivated by the natives of the coast. The berry, though small in size, is very like pea-berry coffee. The fruit is purple, and the crop abundant. This coffee is mostly consumed by the Portuguese on the coast. I collected some seed and sent it to India, but for some reason it failed to germinate.

A striking feature of the flat country on both sides of this range of hills is the 'Mopani' tree, it is gregarious, and grows in patches of from 50 to 200 acres. As a rule only very short grass grows under these trees, in some places none at all. Its habit of growth is very like that of *Terminalia tomentosa* and it has the same ragged and cracked bark; but the leaves are like those of a *Bauhinia*, with this difference, that the leaflets have not the rounded edges of the typical *Bauhinia* leaf but are sharply acuminate. The wood is very hard, of a dark reddish claret colour, and is apparently

durable ; but the Manganje could tell me nothing of its qualities as they only use small poles in the construction of their huts and seem utterly ignorant of the quality or value of the many fine hard woods that I found growing in these forests. The axes they use are so wretchedly small and weak, that they are utterly unable to fell the large trees in their Koomrie clearings, but manage very cleverly and burn them down with fire. They know thoroughly the uses of particular kinds of woods which are used by them for trivial purposes, *e. g.* for making bows, spear handles, musical instruments, walking sticks, etc. A peculiar feature of these forests are the large 'Dambos' or open plains which occur both on their edges and interior. These "Dambos" in the rains are flooded with water and swampy, they are overgrown with various descriptions of grass, but as a rule, are destitute of trees, though some of them are partially covered with swamp *Acacia* which somewhat resembles the Babul* but has a more umbrageous head, and rarely exceeds 18 feet in height. The variety of *Acacias* in Africa is something astounding and they undoubtedly constitute the bulk of the trees in the plains forests.

I returned to Chiromo at the end of September and immediately started for a trip across the Ruo in an easterly direction. After crossing the Ruo about fifty square miles of country along its banks and those of the Shiré, in a triangle, consists entirely of "Masetus." Some of these are a mile apart, some only thirty or forty yards, they all run more or less parallel to one another, but there are connecting glades between them. There are some trees scattered about in these glades, which are the favourite resort of game of all descriptions, including that grand animal, the Sable Antelope. Here I found growing, a gouty looking leafless, Euphorbiaceous shrub covered with the most beautiful pink flowers. All my attempts to strike cuttings failed. Here I had some very good sport. Fish in the Ruo were numerous, and three or four species proved excellent eating. A carp weighing about 8 or 10 lbs. of a beautiful silvery colour with five or six narrow, purplish, metallic stripes on each side, and orange fins and tail, rose readily at a spoon bait, besides taking a minnow : but I had to use gimp on account of their jaws being armed with the most fearfully serrated shark-like teeth. A handsome dark coloured perch was abundant, and easily caught with a locust as a bait. Another species of carp known as "Pendé," with an exceedingly small mouth and minute scales, could only be taken with paste, or raw meat, as a bait. The large carp, known as 'Mafuta,' which I caught in the 'Tuchila' was abundant here, and besides these there was an ugly Barbel-like fish, with a film over its eyes, known as "Nenje," occasionally caught in nets, as also the "Nyumé," a siluroid that the natives were very fond of

* *Acacia arabica*.

smoking. During the rains the "Kassao" or Sawfish sometimes comes up the river and is speared by the natives. It grows to an enormous size.

The flies were exceedingly troublesome, and so were the locusts, tremendous flights of which passed over the camp, and were a source of great annoyance. We had to light fires under the camp trees to prevent them eating all the leaves off, and thus depriving us of our only shade, the young grass which had sprung up to a height of six or seven inches was eaten down to the roots, and such trees as had put forth their spring foliage were stripped bare. It was impossible to walk anywhere when they were about, for they fly up in clouds and hit you in the face so frequently as to make the nuisance perfectly intolerable. Of course all the game cleared out.

As I had arranged to be back in India, and had taken a return ticket for a year, I was obliged regretfully to give up all further ideas of exploration and sport, just at the very time that the latter would be at its best.

I returned to Chiromo on the 6th of November, sold off all my goods and chattels by auction at a considerable sacrifice, packed up my other belongings, and was ready to start by the 9th. I had missed by two days the opportunity of going down by one of Sharrer's house-boats, so had to content myself with a barge as far as Port Herald.

Our way down the river was extremely tedious and slow, for the water was only a few inches deep on the banks, and we were detained more than half way down by a solitary bull Hippo who disputed the passage, until I put an express bullet into his skull. We reached Port Herald on the 12th. To my surprise I found the house-boat still there, with a shooting party on board.

This party originally consisted of Mr. G. M. Morgan, Major Trollope of the Guards and Dr White. Major Trollope had however left them to go up to Lake Nyassa; they had had no sport and encountered many hardships. We had to wait three more days at Port Herald where I stayed with Mr. Galt, the Assistant Collector. At last the long looked for steamer came-up, and we got down to Pinda Marsh after sticking a dozen times in the sand-banks, where the vessel had to be dug out, and towed into deep water by the villagers. In one place, where we stuck badly, Mr. Irwin (Sharrer's manager) and myself had to swim across part of the river to fix the anchor on the bank. After completing this little performance, I found a crocodile contemplating me with a view to dinner from behind a clump of reeds, so I declined to cross the river again and waited for the steamer to be brought to me, which took place about an hour later. At Pinda, we transhipped into another steamer and managed to get down as far as Shupanga without grounding more than two or three times. Here Mr. Morgan, who had suffered the previous night from an

attack of fever, became much worse, and by 3 P. M. died in spite of all the Doctor could do for him, such is the rapidity with which these African fevers often terminate a man's life !

We stopped the steamer, and buried him about a mile distant, under a clump of Palmyra palms.

We finally reached Chindé, 12 days after leaving Chiromo. I had to wait there till the German steamer the "Carl Peters" arrived. In this I had to go south to Delagoa Bay, where I transhipped into the "Kanzler." We touched at Beira and I landed and had a walk about the town.

This place is a small sandspit, entirely surrounded by mangrove swamps and must be very unhealthy. The houses are all built of galvanised iron, and boast of no architectural beauty. The approach to the Bay is decidedly picturesque, there being many forest-covered islands scattered about. We sailed the next day for Mozambique, and once more I had to undergo the miseries of an attack of acute rheumatism in a confined cabin. We reached Zanzibar on the 16th December when I discovered to my disgust that the steamer "Safari," which was to have carried me to Bombay had been ordered by the Directors on a special coasting trip southwards. With much trouble and difficulty I had myself conveyed on shore to the Hotel D'Angleterre where I spent a most miserable fortnight in bed. When I could get about a bit, I went for the few remaining days for short strolls into the country and to the Zanzibar Club, which is a very good one.

The island of Zanzibar is extremely fertile, and the scenery park-like. Thousands of noble mango and other trees are scattered about at intervals, with a pretty green sward underneath. Cocoanuts are also grown, but not to such an extent as to mar the scenery; there are extensive clove plantations and I also found the jack, tamarind, and Malayan durian, naturalised. I bought some durian fruit * for 12 annas each, for the sake of the seed, but I cannot say that the atrocious smell and flavour of this fruit commended it either to my nose or palate. The Custom House was interesting from its piles of ivory, and bags of cloves which rather overwhelmed the neighbourhood with their strong odour. The Sultan has a garden with numerous date-palms in it, all of which were fruiting freely. I noticed some vines too in the town that were fruiting well. The market seemed supplied with mangoes, pineapples, and plantains, in abundance. I saw some fine cattle imported from Somaliland for slaughter. Sheep are scarce and all of the Fat-tailed or "Domba" variety. Camels are also slaughtered and eaten, but the specimens that I saw were the most awfully miserable beasts conceivable. The native town and beach is unspeakably filthy, and it is marvellous that the inhabitants are not decimated by disease. The Sultan has conferred a benefit on the

* Durio Zibethicus.

town by supplying it with fairly good water. He resides in a lofty and well-built palace, facing the sea ; this edifice is lighted at night by electric lamps, there is a clock tower in front of it, which keeps Arabic time, *i. e.*, the hours of the day are counted from 6 A. M. to 6 P. M. the former being 1 o'clock and the latter 12.

On the 2nd of January I sailed in the "Safari" reaching Tanga on the 4th. I landed and went ashore with a German planter of the name of Illish, who introduced me to a French naturalist, who had made a splendid collection of birds and small mammals; amongst the latter, the most noticeable was a rodent the size of a hare with no less than 22 pairs of ribs ! I had to be on board again in half an hour, so my visit was a hurried one. The town is beautifully laid out and the Railway well constructed, the place is decidedly picturesque, the "Usagara" hills in the back ground being visible along this line of coast.

After an uneventful voyage of 11 days, during which we had fair weather, I said good-bye to Captain Ganbé from whom I had received the greatest kindness and consideration on both voyages.

The "Safari" is a beautifully clean steamer, and the food excellent, so I was almost sorry the voyage was over. I left in the "Nawab" on the 18th with Captain Sandilands, and reached Calicut on the 21st ; thus ended my trip to Africa. It had thus taken me nearly two and a half months to get from Central Africa to India !

On overhauling the collections I had made in Africa, I discovered many seeds and bulbs were missing, though these had all been carefully packed for transport. I also found, to my intense disgust, that the jawbones of sixteen head of eland, koodoo, etc., which I had intended setting up as trophies were *non est*. Both my servants had gone to their country to see their families, and they both took very good care not to come back again. These men did nothing but quarrel with one another whilst in Africa, the cook was always threatening my other servant that he would be revenged upon him. All my collections had been labelled, numbered and placed under lock and key, and my servant made responsible for them, but there can be little doubt that the cook made away with them to get his fellow servant into trouble. As for the living plants brought over, notwithstanding the utmost care and trouble, I lost some of the most valuable plants from white-ants at Chiromo, my whole collection of orchids was dropped by the Manganja boy Vicenti into the Zambezi River, he tied a rope to their crate, and plunged it in the river to wet the orchids, the rope broke, and I was not told anything about it till next day !

The lascars on board the various steamers except the "Nawab" and "Safari" did their utmost to destroy the balance of the plants, by wetting them with salt water from the hose, and did actually kill the greater part of them in that way.

R. M.

Lebdieropsis orbicularis in Hyderabad.

This tree (Koorasi-Kodarsi-Nalla Kodarsi, Telugu) is one of the most generally used and important trees in His Highness' Dominions. Although growing to no great size, it is plentifully distributed almost everywhere, except in the Aurangabad Zillah, and is greatly valued in its pole stage. The most favourite poles are those from 18 to 22 inches in girth. They are dressed and split from end to end in the forests and sold in the neighbouring villages and towns at about 6 to 8 annas each. These poles are very durable and quite as popular as Teak. This species has been lately included in the Reserved list of trees, but formerly it was free to all agriculturists and most other inhabitants. The result was that it (in common with many other valuable species) was exploited in lacs. Fortunately, there is hardly any species the reproduction of which is so satisfactory. It coppices splendidly in spite of the fiercest fires, and cattle do not eat the leaves, so it escapes the axe of the herdsman. The wood does not appear to be eaten by white-ants and the young shoots and branches are much used for dunnage for roofs of houses.

It is well known, I believe, that the hard rind of the capsules is poisonous, but I notice that neither Brandis nor Gamble allude to the fact that the bark must also contain some poisonous property, for not only do white-ants leave it severely alone but it is used here for poisoning fish, though said to be scarcely so effective as "Barringtonia" bark. I am told that the inner bark, when placed on the sores of sheep and goats, is efficacious in healing them and in destroying maggots.

W. F. BISCOE.

Influence of Forests on Hail.

M. Claudot, one of the officers attached to the "Station de Recherches" at Nancy, devotes an article to the above subject in one of the March numbers of the "Révue des Eaux et Forêts," and it would appear that experience shews very clearly that a hail-storm which is severe before reaching a wooded area immediately weakens in force over the forest, where moreover, it seems seldom to do much damage, and causes but very slight, if any, harm to the crops on the further side, dying away very rapidly. The money figures shewing the destruction caused in the crops where the hail is severe looks appalling, and if further observation bears out the view above mentioned we may really come gradually (very gradually) to having the country parcelled off into areas of forest intersecting areas of cultivation; for the rather hazy observations at present available on the meteorological effects of forest, not merely in the matter of hail, but also of rain, wind, &c. &c., seem at least to point to the happiest arrangement being one in which cultivation alternates with forest. In the future, when

the socialists have put us all right and set up a form of government which will do everything for everybody, we may perhaps expect sweeping and very "zabardast" (for such a government will be extremely "zabardast") laws ordering that so much per cent. of each parish, or country, shall be under wood. It does not appear sufficient, however, to have mere screens, the wood must be in fairly large masses to affect the hail. As yet, of course, the observations made are insufficient. It is not known, for example, to what extent the orography of a country affects hailstorms.

M. Claudot quotes Becquerel, a "savant" who studied this subject in the sixties. The latter brought forward two theories. the first was that the forest stopped the masses of air, which caused these to collect and to flow along the borders; the speed being thus slackened a fall of hail took place in front of the forest. This, it seems to us, might mean that a forest area was actually harmful. It was, however, answered by another "Savant," who pointed out that the height of a forest was scarcely likely to have much effect when it was recollected that storms were probably formed at some 2,000 metres above the earth. M. Becquerel's second theory was that if we accepted Volta's notion that electricity had something to do with the formation of hail, the trees might act as lightning conductors and thus extract the electricity from the clouds.

Why should there not be a "Bureau de Recherches" established to consider these and all other matters of a like nature? Perhaps the meteorological observations could be best undertaken by the Meteorological Department, but besides the meteorology of forests there are a thousand and one matters calling for careful study by Foresters, and inasmuch as the great difficulty is to collect, and place on record in a form which can be got at by all, the observations that are made in a desultory way here and there by Forest officers and others, we think there should be a special officer for this business and he should travel from Province to Province and write reports, which might be published *in extenso* in the "Indian Forester."

"Q."

Forest Officers as Photographers.

We are asked to draw the attention of our readers to an article in the 'Révue des Eaux et Forêts' for February 1895 entitled 'Le Forestier Photographe.' The writer explains the importance of photography as an aid to reports shewing the progress of works of reproduction or 'reboisement'; he points out what an advantage it would be in cases of storm, frost, fire and other disasters to have the reports supplemented by photography; he shows how useful it might be in the case of works of construction to shew what they are like; and especially he recommends periodical pictures taken with a camera printing vertically upwards to shew the gradual closing up of the canopy of a forest.

The future supply of Indiarubber.

Some twenty years ago sinister rumours as to the depletion of the rubber forests of South America caused a new departure

in economic botany, namely, the systematic planting of rubber trees, and the results may be considered satisfactory as far as the possibilities are concerned, although the garden product, as we may term it, has not yet entered into serious competition with that from untended nature. The question now arises as to whether all the time and trouble has been expended needlessly or not. From what has appeared recently in the American technical press, this would appear to be the case, and it seems of some interest to briefly recapitulate those criticisms on what is almost entirely an English enterprise. Attention is drawn to the fact that vast forests of rubber trees exist untapped, and that any fear of curtailment of supply is illusory. This statement is supported by the fact that the market price of rubber remains practically stationary, while the demand has largely increased of recent years. A critic remarks that there is no good in doing what nature has already done so well for us; and another practical man, when asked why he did not support the rubber plantations, made answer by the query, "Why do I not go in for the cultivation of coal?" *These and similar remarks go to show that in America there is no fear as to the supply running out, and that, therefore, any precautionary measures which prudence might dictate are unnecessary and uncalled for.* The American business man cannot see any pressing need for the movement under consideration, and he is unwilling to embark his capital in an affair the benefits of which, to him at any rate, are so problematical. With regard to this point of unlimited supply, it may be noted that recent travellers in the upper parts of Brazil report that there is a large unworked area of rubber forests in the watershed of the Orinoco, and even where the forests are worked it is only in rare instances that more than the borders of the stream have been tapped, no trouble being taken to get spoil from the higher regions. Further than this: there is a constant succession of trees arising from seeds. Count de Berthier has expressed the opinion that the Venezuelan forests could be made to yield 1,000 tons of the best rubber per annum if carefully worked, and is supported in his optimistic tone by what the Baron de Marajo has written in a recent number of the *New York India Rubber World*.

In Africa, although the supply is abundant, the want of navigable rivers has acted prejudicially against the due expansion of the trade, as under the conditions of portorage at present obtaining in many localities, the natives find it unprofitable to carry rubber any distance to the coast when the item of paying tribute to the various tribes encountered *en route* has to figure in profit and loss accounts. While on this matter of Africa's addition to our supply, we should like to take the opportunity of referring to the statement of M. Chapel that if the African rubbers were collected and prepared for market by the more enlightened methods in vogue in South America, the resulting product would be

equal to the best Para rubber. We confess to a mild feeling of surprise at this statement, and consider it a bold assertion which is not supported by the facts of the case, though, as it must be remembered that some kinds of African rubber are much superior to others, the author quoted may have had in his mind the best of the African sorts. As regards the bulk of the rubber, that from the *Landolphas* or the species of *Ficus* found on the west coast, we think the day is very far distant which will see them improved to the standard of Para rubber, though we certainly do not doubt that some amount of improvement is possible, and indeed, to our own knowledge, this has been effected of recent years in the case of the Lagos rubber, which, though at first practically worthless, now fetches a fair price in the market. However, we are rather wandering away from the lines of this article, and to return to the critics of the rubber plantations, it may be noted that they prognosticate great difficulty in obtaining labour if the plantations are carried out on anything like a large scale. The Indians, it is asserted, will not change the whole course of their lives and submit to the entire revolution of their methods of work, while it has been amply demonstrated that Europeans or Asiatics are incapable of sustained work in the climate. Other objections have been urged, but in face of the chief one, *viz.*, unlimited supply, there seems but little use drawing attention to them. The case then seems a tolerably clear one for those who argue that rubber plantations are not warranted, by the facts of the case. In passing judgment, however, on those who, in the light of recent discoveries, may seem to have acted somewhat precipitately, and without the exercise of due foresight, we should, of course, bear in mind that the common facts of to-day were not the common facts of 10 or 20 years ago. The discovery of these rubber forests is of recent date, and it cannot, therefore be pointed at as an overlooked factor in the original consideration of the matter. It will be remembered by those interested that the representations made to our Kew authorities as to the depletion of the rubber forests, were couched in distinctly alarmist language, and therefore they quite merited the measures taken by the India office. Of course it was possible for our Government to have undertaken such explorations as to have recently been made by private individuals, and this would probably have resulted in the alarmist rumours being somewhat discounted as we may presume that the forests of to-day existed in much the same condition 20 or 30 years ago. However, it is easy to be wise after the event, and we shall certainly not be found in the ranks of those who seek to throw ridicule on the whole movement, because, whether the expense and trouble which our Kew authorities have been put to, seem warranted or not at the present time, it has certainly been shown that rubber trees can be successfully acclimatized and grown in India and other districts far remote from their original *habitat*.

and occasion may yet arise when the information thus gained may prove of much value to the indiarubber industry.

Comment by an American Importer.

A gentleman thoroughly familiar with the conditions of trade and industry in Central and South America entertained somewhat different views from the above. "While," said he, "it is true that not much capital, American or foreign, is invested in rubber plantations, the question is certainly in the air, and before long the vague notions and ideas on the subject will assume practical shape. The rubber countries are poor and naturally anxious to attract capital from outside to develop their industries and resources. On the other hand, it is beginning to be felt that some measures have to be taken to insure the future supply of the ever-increasing demand for rubber. As population grows and as new applications or extensions of old applications of rubber in industry, are made the demand for rubber increases, and it is a short-sighted policy to depend on existing rubber forests, which surely cannot last for ever and access to which must become more and more difficult and expensive. Not only will rubber plantations be needed, but there will be more profit in them than in going to the inaccessible forests for the supply. The business world is not entirely ripe for it, but the subject is in the air, and you may expect to see the starting of a great many enterprises in that direction before many years go by. It is, however, to American capital that we have to look for this. Foreign capital will not go into anything, the price of which is controlled by this country. We consume two-thirds of the rubber product of the world and hence control prices. In twenty years our consumption has risen from less than ten millions to not far from forty millions. The rubber countries look to us for capital. The natives in South and Central America have already begun the planting of rubber trees, and a traveller will meet here and there plantations of considerable importance. But American capital will do the real work when the time is ripe. There is, however, one serious drawback—the lack of labour. There is no civilised population in the rubber districts and the Indians cannot be depended on for regular, systematic, and continuous application. They are not accustomed to order and discipline, and they will work in their own way, getting drunk or loafing whenever it suits them."—*India Rubber World*.

The destruction and repair of Natural resources in America.

By JOHN F. LACEY, M. C., Oskaloosa, Iowa.

The people of this continent do not sufficiently appreciate the immensity of the period that nature employed in building the New World and preparing it as a home for civilized man, nor how easily those advantages may be destroyed. When first Columbus set his foot upon these shores the vast forests and splendid prairies lay rich and inviting as the home of the coming race. The forest, which has done so much to prepare the earth for man's use, was encountered by the early settlers along the whole Atlantic shore. The necessity of clearing away this vast mass of vegetation led the pioneer to look upon the woods as the enemy of man. The axe was used unsparingly, and but few specimens of the original continental forests still remain.

Trees have their poetic as well as their practical side. While sensible to their beauty, we are now deeply concerned in their utility. All they have asked heretofore has been standing room. Give them but place, and they will patiently do their work. Their long arms have reached out for ages, and gathered from the air the elements of growth which they have added to the soil. As one poet has expressed it :

" Cedars stretch their palms like holy men at prayer ;"

and another speaks of them in winter,—

With their bare arms stretched in prayer for the snows."

They gather the sunshine year by year and store it away for future use. They fertilize the soil ; they beautify it.

In a few old churchyards on the eastern shore of Maryland may be seen the remains of the splendid forest that once covered that region. The sight of these specimens makes us regret that

larger areas of the ancient forest had not remained untouched. It was necessary to cut down a part of the forests, but man has swept them from the earth with the besom of destruction.

We are beginning to realize the wastefulness with which we have treated the gifts of nature. We found this continent a storehouse of energy and wealth. The climate was salubrious. The soil was fertile. The forest spread on every hand. The rivers teemed with fish. The earth and air alike furnished supplies of game. Great coal deposits were found in almost every State. Coal, oil and natural gas arose to the explorer from the bowels of the earth.

The prodigality of the sun is something amazing. When we think how few of its rays strike the earth or any of the planets in proportion to those that are constantly shed from its surface we are led to wonder if they ever can be exhausted. Man is as prodigal of his natural possessions as the sun of its heat, light, and energy. We have not been content with improving upon nature, but have acted the spendthrift part, in wasting her stores. The coal has been preserved in spite of man by vast strata of earth and stone, and there has been less wasteful extravagance in the use of this valuable mineral than, perhaps, any other of nature's gifts, and yet we are beginning to compute the time when the anthracite will only be found in the collections of museums. The coal oil has been wasted, and wells have been opened and fields destroyed as though the supply was inexhaustible. Natural gas deposits have been tapped, and the wasting gas set on fire, lighting the country for miles around. These vast stores of nature's forces are being rapidly exhausted.

It has not been so very long ago that terrapin were so plentiful in Maryland that it was found necessary to enact a law preventing masters from feeding their slaves more than a given number of time, each week upon that toothsome viand. Terrapin three times a day, three hundred and sixty-five days in a year, was found to be monotonous. No such law would be necessary now. In Connecticut the law forbade that an apprentice should be required to eat salmon more than twice a week for the same reason that the slave was protected against too much terrapin. Now the Connecticut salmon is a delicacy for the rich alone.

The extermination of the buffalo is too recent and too shameful to speak of excepting in the highest terms of indignation. Instead of taking these vast herds and, after giving them proper marks of identity, dividing them up and assuming proprietary rights over them, they have been slaughtered by the hundred thousand for the sheer pleasure of killing, until now a little handful of two or three hundred is all that is left of the millions which roamed the plains forty years ago; and this was called sport. It required nothing like the expert skill of the pig-sticker, who, covered with blood presides over the scenes of carnage in one of our great slaughter-houses.

The same indiscriminate slaughter which has practically destroyed the salmon of Connecticut has been followed on the Columbia. Fish-wheels along the banks of the stream have been throwing out of the water enormous quantities of the most beautiful fish in the world, catching them at the very time when they were *en route* to the headwaters of the stream to deposit their spawn. Legislation upon the part of Oregon and Washington has at last been reluctantly enacted in time, I trust, to save these fish from extermination.

It is to the forests that we wish more particularly to direct our attention at this time. But the streams are the children of the forest, and the fish are the children of the streams. In the early days men often cut down trees for the wild fruits that grew upon them. The beautiful service-berry has been well nigh exterminated by this barbarous practice. This was a sin against nature. A few years ago I visited the great region of the Northern Pacific Coast, where to-day is perhaps the grandest forest now remaining on the face of the earth. It can no longer be described as

"the continuous woods
Where rolls the Oregon, and hears no sound
Save his own dashings ;"

for the hand of man is busily engaged in building up new States in that splendid country. Arriving upon the cars at The Dalles some one said to me to run out quick and I would see Mount Hood. I presumed Mount Hood was one of the permanent features of Oregon and I saw no reason to be excited or to hurry to see it, and took a little time to go to the point where the peak could be seen through the open street. I watched it for a moment and then the smoke and fog covered it. It was the first and last glimpse I ever had of Mount Hood. The whole country was covered with a pall of smoke. The same "improvement" was being perpetrated there as in early days on the Atlantic Coast. The promised destruction of the world by fire was progressing.

Splendid trees, five and six feet in diameter and hundreds of years of age, were being destroyed. Auger holes were bored in the tree near the ground, coal oil poured in the holes, a match applied, and the tree burned down. Other holes were bored in the body of the tree, and with the assistance of more coal oil a splendid tree was soon reduced to ashes. During the dry season these fires were permitted to escape and pass through the forests, covering and concealing the whole earth with a cloud of smoke, and rapidly working in this new field the same useless destruction which has followed in man's footsteps in every part of the continent.

This sin on the Pacific Coast is only greater than that which was committed on the Atlantic shore, because the forests are finer, and the mistakes made in the wanton destruction of

the timber in the East ought to have been a warning in the West. They have an awful example to shun and not to follow.

In the hills of Virginia and West Virginia I remember in my boyhood days the little streams that were fed by springs, and favorite swimming holes could be found along them all. They were full of fish, and a source of delight to the young and old. After forty years' absence I re-visited some of the same old streams. The trees had been cut from the hillsides. The springs had dried up. The old swimming holes were gravelly and sandy wastes,—as dry as Sahara, except where the channels were filled with muddy torrents for a few hours after a big rain.

In the older settled parts of the country the same condition of things occurred much longer ago.

I believe it was in 1842 that Doctor English described a similar condition, asking his old schoolmate to remember—

“ The shaded nook by the running brook
Where the children went to swim.
Grass grows on the master's grave, Ben Bolt,
And the spring of the brook is dry. ”

This wail touches the heart in every part of the settled portions of the country.

In Central and Southern Italy the Apennines are a striking illustration of the results of forest destruction. The ghastly seams into which the rains have washed lands that were once as fertile as any in the world have utterly destroyed much of that country for agricultural purposes. Surrounded as Italy is by the Mediterranean, the effects upon her climate have not perhaps been as bad as would follow in the interior part of the continent. But nature seems to have given up the struggle with man, and Hawthorne tells us that where man's hand has carved a stone in Italy its reclamation from nature is permanent, whilst in the north of Europe, or in the British isles, nature claims its own again, and covers the bricks and rocks with moss, lichens, or ivy.

Nothing is so beautiful as a running stream in a state of nature. It is a living thing, always sparkling, never growing old. The brook, where the forests still protect it from destruction in its course to the sea, is a symbol of eternity. To the poet it says —

“ Men may come, and men may go,
But I go on for ever.”

But in the land of the Holy Writ, where the forests were but few, the brook was no such type of constancy. In Job, the brook is described as an emblem of deceit, frozen up in the winter and dried up in the summer: “ My brethren have dealt deceitfully as ‘a brook, and as a stream of brooks they pass away. * * * The ‘paths of their way are turned aside; they come to nothing and ‘perish.”

The brook that Horace describes in his journey to Brundisium still flows in the same banks, and seems like a living thing, speaking of the poet of two thousand years ago.

The Hon. Timothy Brown, one of the leading lawyers of Iowa, has a discouraging theory which he supports with a considerable array of corroborating facts. He assures us that the magnetic pole is moving eastward at the rate of seven miles a year, and as it moves the area of drought in the Rocky Mountain region progresses at the same rate, and in due time Ohio will be as arid as Wyoming or Nevada.

We must not mistake mere weather for climate. We may have a scarcity of rainfall, and that scarcity may become serious enough to lead us to apprehend a dangerous permanent change of climate, whilst it may be true that a similar condition of things has prevailed many times in the past in the same region, followed by a return of sufficient moisture.

But it seems to be the united opinion of all ages and in all countries that rain produces forests, and that forests produce rain; that great and injurious changes of climate almost certainly follow any sweeping and general destruction of the woods.

Trees set out along hedge rows will undoubtedly do much in ameliorating climatic conditions, but great masses of forest, where considerable regions are shaded and protected, are essential to the preservation of the climatic conditions that have brought so much prosperity to this country in the past.

In the North-west the last few years of drought have prepared the people as a whole for the study of this question. The shrinking of the Great Lakes is already plainly noticeable, and active efforts for their preservation and restoration should be made without delay.

In Iowa some of the most beautiful of the little lakes have been drained and turned into fertile fields, whilst others have dwindled so as to be only a mere reminder of their former beauty. If the destruction of these bodies of water only entailed the loss of their beauty, a practical people might accept the change without any very great regret; but when the reclamation of a comparatively small area of land to cultivation imperils the water supply of thousands of surrounding farms, it is high time to call a halt and demand a restoration of these sources of water supply. All land must at times lie fallow. The best rest that it can enjoy is when covered with timber, it returns for a time to its natural condition sheltered and fertilized by the woods once more. A reasonable portion of the country should at all times be thus given up to its native woods if we would preserve the fertility of the whole.

The practical question of to-day is how, as far as possible, to undo the mistakes of the past; how to prevent them in the future. Agitation and discussion are necessary to call the attention of the people to the importance of maintaining and to at least partially restoring, the primitive forests of this country. The recent policy of

withdrawing from settlement or sale large regions upon the headwaters of streams, and creating forest reservations, is the greatest step in the right direction that has thus far been taken.

We must give up some part of our country to nature in order to keep the remainder for ourselves. The policy of most of the old States in regard to timber has been well summed up in six words: "To get rid of the timber."

With wood used for nearly every purpose from toothpicks and matches up to great grain elevators and ship's masts, the proper and reasonable requirements for man's necessity and luxuries involve great and constant encroachment upon our forests. The old backlog of our forefathers has given place to the terra-cotta gas log of a new generation.

With barbed wire for fencing, and the decrease of wooden houses in the larger towns and cities, the overworked forests ought to have some rest. But the increase in population and the wear and tear upon old buildings make such calls for timber that, of necessity, a great drain upon the old forests continues.

Our fathers cut down beautiful black walnut trees for rails, and our own generation has pulled up the old stumps of the same tree for furniture making.

The peasants of France during the Revolution, it is said, would cut down two trees to make a pair of wooden shoes. Mark Twain, a few years ago while in Paris, promised to send as a wedding present to a friend the rarest and most expensive thing he could obtain in that city, and selected two small logs of fire-wood for that purpose, and, tying them together with red, white and blue ribbon, laid them among the bric-a-brac at the wedding reception.

We ask ourselves what remedy we should adopt in America. This is more easily asked than answered. To call the attention of the people to the mistakes of the past before it is too late will lead to a conservation of groves and forests still in existence. The destruction from fires has already attracted much attention, and rigid laws to prevent them have been enacted in every State.

Groves and small wood-lots upon each farm will, in some measure, repair the loss of the more extensive woods, but there must be considerable areas of country in which the forest must take control if we would preserve the climate, the springs, the streams, the soil, the birds, and the fishes. Even now the business of sinking wells for farm use to a depth of several hundred feet is being actively carried on in the West. The surface water is disappearing.

Private owners cannot perform the duty of forestry in America. We have no rich old families who from generation to generation have been able to set apart large tracts of land for the growth of trees. We have none of the beautiful old ruins that grace so many parts of the forest-planting kingdoms of the Old World. We

have no ruins more picturesque than a defunct bank, a bankrupt insurance company, or a railway in the hands of a receiver. No baronial game preserves are set apart in America. Only the Government lives long enough to plant trees extensively. The private individual is too constantly reminded of the fleeting character of life to lay out a forest for succeeding generations. The Government alone can hold tracts either long enough or large enough to effect the great climatic purposes involved in the preservation of our forests. A great step in this direction was taken in the laws providing for timber reservations. These reservations should be kept for use and growth. A thorough system of cutting of this timber ought to be provided for at some time in the future when the wants of the people require that the ripened or dead trees should be utilized. But this should be done with such system as to preserve them as a whole.

The people should be taught the value of these reservations by thorough education upon the subject. Arbor Day celebration and the planting of fruit and timber trees will lead a new generation to realize that the forest is not the enemy of man, but his fast friend—a friend without whom nations cannot expect to prosper.—
(Proceedings of the American Forestry Association.)

Too much fire-protection in Burma.

No. 1.

I have read H. S.'s remarks in his article "Too much fire-protection in Burma" with the greatest interest and pleasure. Having worked in the same Division as H. S. and now as District Officer of a Division in Burma in which there is a good deal of fire-protection attempted, the remarks were of special interest to me.

From beginning to end, with the exception of the clause about statistics, to which the Honorary Editor has objected, I am in accord with the writer. I have tried the figures given in some of our Burma working-plans of the number of teak trees below three feet in girth, dominant and suppressed, in and adjoining fire-protected areas. They are quite useless for argument. They might be used on either side. The fact is that countings, &c., are only made of a small proportion of the crop, not one-third; the growing stock being deduced from these countings. To be of any use, accurate countings of all seedlings of teak on fairly large well-defined areas within and in similar forests adjoining the fire-traced areas would have to be made from time to time.

Everywhere I notice that the number of young plants of teak (and of cutch, too) are very much more plentiful in the forests which are every year burnt over than they are in the fire-traced areas; the only exception is that of patches where the bamboo has flowered. The reason of this is clear enough: light is necessary for a young teak to flourish and the burning of all grass and *débris* by the yearly fires supplies this want. These fires occurring annually, they are not very fierce, so that the young teak plants do not get destroyed outright, and when once they get their crowns free they go ahead; fire-protection is then beneficial. Want of light is a worse enemy to a young teak seedling than the ordinary jungle fire. A young seedling, after it has once germinated, would, under ordinary circumstances, in a protected area, go struggling on from year to year until such a time as the bamboo flowered or external help were given.

When there are plantations, however, fire-protection must of necessity be resorted to and continued for a certain period. The question is, how long is the fire-protection to be maintained?

In the Burma working-plans it has been shown that a teak tree takes 150 to 180 years to attain marketable dimensions. This is in natural forests. Perhaps, in plantations, with fire-protection at first and with the aid of weedings and thinnings, 120 years would suffice. Are we to go on fire-protecting for 120 years? Would not doing so bring in a very poor return on the money expended? What I think necessary is, that the plantations should be protected from fire until the young trees are about two feet in girth at breast height, and the plantation has received its first thinning. On a teak tree of this size fire has no effect, unless there is an enormous amount of dead dry wood surrounding the tree.

A girth of two feet is reached in about 15 years. My idea is that if the plantations were protected from fire for 20 years (20 years is taken so as to be well on the safe side), it would be sufficient. In the 21st year, i. e., the first year that fire-protection has been discontinued, it would probably be advantageous to set fire to the leaves, &c., early in February. This would lessen the danger should fire come in later on, as it most certainly would, as much of the inflammable matter would have been burnt.

H. S. mentions humus incidentally; I agree with what he says, but would like to state that I have during the present year been carefully looking out for humus in those areas which have been fire-protected for the longest time, and that most successfully. Not once have I found humus; earth-worms, white-ants, &c., seem to eat up all the leaves and work them into the soil.

The plan for fire-protecting the whole of the Pegu-Yoma reserves *en masse* is on paper undoubtedly a very pretty one, but where is the labour to come from? roads and tracks crossing the Yoma from the Irrawaddy to the Sittang Valley would all have to be traced. Should a fire start or be started near the main range, when would it be found out? and how would it be put out if detected? There are no villages near. Often the nearest village would be 20 to 30 or more miles away, and before help could arrive and the fire be put out, thousands of acres would most certainly be burnt. The ante-penultimate para. of H. S. is all to the point.

F. J. B.

No. 2.

H. S.'s article in the May number of the *Indian Forester* has no doubt given many readers of the *Indian Forester* food for thought, and it will be interesting to hear what our colleagues in Lower Burma think of his ideas on the question of protection from fire there. It has not yet been my fate to serve in Lower Burma, but I have some knowledge of the Upper Burma teak forests, as well as of teak forests in India, and I imagine teak forests are much the same wherever they grow, though perhaps the reproduction of teak is better in Lower Burma and the growth of young teak faster than in India. It is, however, reasonable to assume that the effects of an ordinary jungle fire are of a similar nature in any teak forest. Now I must say that my observations lead me to differ from H. S.'s conclusions as to those effects. He says: (a) that thanks to its hard exterior, the teak seed is only charred and blackened on the outside, but its vitality is in no way impaired by the fire. My experience is that the seed is often burnt up altogether and even when not burnt up its vitality is often impaired. I have frequently cut open scorched teak seed and found the kernel shrivelled up and useless. (b) H. S. admits the evil effects of fire on young plants, but I am not so sure that he is right in regard to the yearly increasing vigour of the root shoots. This may be true for the first year or two, but constant burning down tends to injure the

bottom of the stem and induce disease which gradually impairs the vitality of the shoots. What really happens is that the shoots get burnt down till some year when it accidentally escapes fire or the fire is too light to hurt it, the shoot then escapes damage and by next year may be high enough to be out of harm's reach with extra layers of bark to protect its lower stem. I quite concur with the 'general belief' noted by H. S. that the damage done by fire to the underground stem of young plants is responsible for much of the hollow timber we find in our forests. This in itself is a weighty argument in favour of protection from fire. (c) H. S. says "on the teak tree with its protecting outside layer of corky bark the fire has absolutely no effect." This may be so in Lower Burma, but I 'hae my doots.' It is certainly not so in any forests that I have seen. Teak trees are, as a matter of fact, often badly injured by jungle fires, a heap of *débris* of dead bamboos and such like gets collected at the base of a tree and makes an enormous fire scorching the bark right through and killing it. Sometimes the tree is killed outright, in other cases a large piece of dead bark falls off leaving the wood unprotected to become gradually eaten into by future fires, the weather and insects. (d) Does all other vegetation suffer more severely than teak as H. S. asserts? I should certainly say not. It all gets equally burnt down, but does it not spring up again quite as fast, if not faster than, his lordship the teak plant? Take, for instance, the *Terminalias tomentosa* especially and the *Grewias* and the *Lagerstroemias* and just think how they go ahead hand over fist after a jungle fire! I think it would be safe to lay odds against the teak in its race with these others. Again, take the *kaing* grass and we shall, I fear, find our teak plant again badly worsted.

No doubt, germination is aided by the burning away of brushwood, provided the canopy is sufficiently open, but we do not want annual fires for germination.

On the whole, then, though I admit that H. S.'s conclusions are nice and comfortable, I cannot see that annual fires can ever be anything but prejudicial to teak forests, and I believe it is sound policy to extend protection as far as funds and administrative considerations allow.

F. B. D.

No. 3.

In his article in the *Indian Forester* for May last, H. S. assumes that the forests of Burma having been annually burnt ever since time immemorial, the teak tree has gradually adapted itself to the situation, and now thrives better under the stimulus of fire than without it.

It must be admitted that teak does withstand fire better than many other trees, but there seems no reason to suppose that this is the result of adaptation, for other trees have been exposed to precisely the same influences and have not developed means of resisting the effects of fire.

Forest fires have probably taken place from time to time ever since Burma has been inhabited, but it by no means follows that they have always been of annual occurrence. Even now in the more sparsely populated districts the whole forest is not burnt through every year; a portion nearly always escapes, sometimes more and sometimes less, according to local circumstances; it is therefore only reasonable to conclude that in days gone by when the population was very much smaller than now, the proportion of forest annually burnt was much less.

H. S. altogether ignores the effect of annual fires in causing erosion and the consequent deterioration of soil and vegetable growth. On fairly level ground, covered with forest of a moist type with little undergrowth, annual fires possibly do not do much harm to teak trees when once the latter have reached the sapling stage, but in dry forests and especially on sloping ground the ill effects are very apparent. In such conditions, the soil deprived of its protecting cover is every year washed away to a very appreciable extent, which is shown by the fact that stones, logs and even small sticks scattered about in the forest do not rest on the general level of the ground but are supported on pinnacles of earth often several inches high, which have been caused by the washing away of the surrounding soil.

The teak tree loses its tap root at a comparatively early stage in its existence, and the exposure by erosion of the lateral roots causes an abnormal development of buttresses with resulting unshapely stems.

This has been repeatedly observed in comparing sections of trees from plantations which have been regularly burnt with those from protected areas. In these buttresses dead leaves and other inflammable materials accumulate, and the fire when it comes is fiercer than the bark of the tree is able to stand. An examination of almost any forest in Burma will show that on the slopes and ridges there is hardly a single tree of 4 feet girth and upwards which has not at its base one or more inverted V-shaped patches on which the bark and sapwood have been entirely killed. In extreme cases, the fire eventually gets right under the tree and it is not at all uncommon to find an old tree standing raised on its side roots so that one can see right underneath it.

Although, at first sight, it may seem improbable, it is my opinion that annual fires are in a great measure the cause of the encroachment of evergreens in deciduous forests. Under ordinary circumstances the fire regularly stops at the edge of the evergreen patches, and the deciduous forest being cut back, while the evergreen remain unchecked in growth, the tendency is for the latter to spread at the expense of the former.

In connection with this I may mention that I recently came across a patch of forest which consisted of a number of old teak and other deciduous trees standing rather far apart with a light

undergrowth of grass, climbers and evergreen seedlings. All the trees had their bark charred and blackened by fire to a height of about 40 feet. A Burman who was present explained this by saying that the patch had been formerly occupied by an undergrowth of bamboos which had flowered and died a few years previously. At the time of my visit there was not a trace of a bamboo to be seen. The young plants had probably been destroyed by the intensity of the fire and their place subsequently taken by seedlings from a neighbouring belt of evergreen forest. A few years hence this patch will probably be a dense evergreen jungle with a few teak trees scattered through it.

It is a generally accepted fact that in forests of a moist type continued fire-protection is antagonistic to the reproduction of teak, and that a judicious use of fire is under certain circumstances fully justifiable; but having once secured reproduction it may be taken as a general rule that the less the forest is burnt the better it is for the teak.

In conclusion, I would point out that the theory put forward by H. S. that the teak tree prefers a soil devoid of humus is opposed to the fact that the best teak is generally found on well drained alluvial flats on the banks of streams where the soil is entirely composed of fine earth mixed with vegetable remains washed down from higher ground.

J. W. OLIVER.

Notes on Forest Operations.

In our number for March 1895 (Vol. XXI, p. 101) we published a Circular on this subject from the Inspector-General of Forests.

We have now received from him copy of his Circular No. 1 of 6th January 1896, which is the outcome of the opinions obtained from the different Conservators and duly considered; and he asks us to explain that "what is required in the matter is a journal, a ledger in which would be entered methods of working,

'&c., based upon the experience gained in past years in connection
'with forest management, new proposals and schemes finding
'their place elsewhere.'

We hope the Inspector-General of Forests will not mind our
again expressing the hope that old contributors to this Journal
will not consider it necessary to cease their contributions and
their support to the Magazine.

"Replies having been received to the Circular from this
'Office, No. 2, dated 31st January 1895, generally approving
'of the arrangement sketched in paragraph 4 for the record of
'notes on forest operations, I have the honour of inviting you
'co-operation and that of the officers serving under you in the
'compilation and editing of notes on the lines already indicated."

"2. It has been suggested that the following subjects should
'be included amongst those enumerated in paragraph 4 of that
'Circular :—

'Injuries done by insects, fungi, etc.,

'Rates paid for forest work,

'Miscellaneous ;

'and to these or any other further additions that circumstances
'may render desirable there can be no objection.'

"3. A suggestion that each officer should be supplied with a
'note-book showing the headings, with a few blank pages after
'each, does not commend itself to me ; for the reasons that
'officers will, as a rule, confine their notes to a limited number
'of subjects, and that an invitation to write on all subjects is
'likely to lead to the omission to write on any.'

"4. Some officers have expressed the opinion that the notes
'could conveniently be published and discussed in the *Indian*
'*Forester* ; but there seems to be doubt whether these notes,
'which relate more to local matters than to specific points or
'subjects of general interest, would be generally read in a
'magazine, and I am disposed to think that the publication of
'such papers as are suitable for discussion in the *Forester* is
'quite apart from the preparation and printing of notes on local
'customs and works.

**Amount of Charcoal required in the production
of Iron.**

Extract from a short Report drawn up from information kindly supplied by the "Oesterreichische Alpine Montan Gesellschaft," a company which owns and works nearly all the mines in Styria and Carinthia.

Question 5.—How much charcoal is used per ton of pig-iron produced ?

Answer.—The output of the smaller furnaces varies for white pig-iron, from 24 to 32 tons per 24 hours. The large furnace (No. 3) in Vardernberg produces 60 to 65 tons in the same time. The consumption of fuel is 70 to 80 per cent. of the output for white pig-iron. Grey Bessemer, or foundry pig-iron, cannot be made under 0·9 to 1·0 ton of charcoal per ton of pig-iron. The output of these sorts is about 20 per cent. smaller than in making white pig-iron.

Question 6.—What kind of wood is generally used, and how many tons of wood are required to produce 1 ton of charcoal?

Answer.—The woods employed for making charcoal are mostly fir (*Pinus Abies*) or beech. The consumption is about 4 tons of wood per ton of charcoal.

All the charcoal is produced in open heaps (*meilern*) and not in kilns.

The charcoal from kilns is not so good, and is more expensive, as the wood must be brought to the kilns, whereas the "*meilern*" can be established wherever the wood is cut.

The charcoal is brought to the neighbourhood of the mine, i. e., to the ore, and not *vice versa*. The so-called "soft charcoal" (made from soft wood) is mostly obtained in the vicinity of the iron-works, or at a distance not greater than from 40 to 50 miles; whereas the hard charcoal (made from beechwood) is sometimes brought from 100 to 200 miles to the blast furnace.

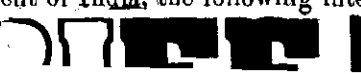
Note.—This extract came to us from the Inspector-General of Forests, who thinks that the reference to the comparative values of charcoal made in *meilern* and in kilns is important as coming from an authority on practical mining, *not* a Forester.—HON. ED.

Turpentines of *Pinus Khasya* and *Pinus Merkusii*.

We have received the following letter and enclosure from the Reporter on Economic Products:—

“As requested by the Government of India, Revenue and Agricultural Department, I have the honour to forward herewith a printed copy of letter No. 3--49-69 (F. S. S. No. 78), dated 28th February 1896, being a preliminary report on Turpentines from *Pinus Khasya* and *Pinus Merkusii* furnished to this Office by the Secretary and Director, Imperial Institute, London.”

“Professor Armstrong, a Member of the Committee of Advice of our Research Department, has just furnished me with a preliminary report on Turpentines from *Pinus Khasya* and *Pinus Merkusii*, of which supplies were furnished to him some time ago ; and I have the pleasure of communicating, for the information of the Government of India, the following interesting results of his examinations”



"The crude turpentine from *Pinus Khasya*, which was a grey thick, pasty mass, containing a quantity of small pieces of wood, furnished by distillation with steam about 13/100 of its weight of oil; while the product from *Pinus Merkusii*, which was more fluid and clearer in appearance than the other, yielded nearly 19/100 of oil by corresponding treatment."

"On a former occasion Professor Armstrong obtained from a sample of *Pinus Khasya* 17 per cent. of oil, and he believes, therefore, that the particular sample now operated upon was collected under less favourable conditions, and that some of the oil had been lost by evaporation before the supply reached him."

"The original turpentine and the distilled oil in each case have a very slight but agreeable odour, less pronounced in character than that of French turpentine, but distinctly characteristic. In this respect the oils from the two turpentines were very similar. Professor Armstrong has satisfied himself of the identity of the oil from *Pinus Khasya* with that which he examined several years ago, and which is referred to in pages 20 and 21 of Hand-book No. 7."

"Considerable difficulties attend the determination of the precise chemical composition of oils of this class, and methods with this object in view are, at the present time, in course of elaboration. Such experiments as Professor Armstrong has been able to make, have satisfied him that the oil of *Pinus Khasya* is strictly comparable with French oil of turpentine. This conclusion corresponds with that which he arrived at several years ago, as stated in the Hand-book. In this respect the oil from *Pinus Merkusii* closely resembles that of *Pinus Khasya*."

"Both oils distil within a very narrow range of temperature, near to 155°C., as does the furnished oil of turpentine; but the oil from *Pinus Khasya* appears to contain a somewhat larger proportion than the others of a constituent of higher boiling point."

"The two oils are very nearly alike in relative density, viz:—

	<i>P. Khasya.</i>	<i>P. Merkusii.</i>
'At 20°C.	·8627	·8610

"They both turn the ray of polarised light to the right, the so-called specific rotatory power being—

<i>P. Khasya.</i>	<i>P. Merkusii</i>
'36"·28	31"·45 "

A similar result was furnished by the oil from the sample of *Pinus Khasya* formerly examined. The rotatory power of French turpentine is practically always about 36."

The difference between the oils from the two Burmese turpentines is not of a kind to be of any practical importance. They are essentially similar, the slight difference between them being due to the presence in one or other of a small quantity of some substance in addition to the chief constituent. Practically they correspond exactly in properties to French oil of turpentine. Pro-

fessor Armstrong is disposed to think that the oil of *Pinus Merkusii* may be more uniform than that from the other turpentine. He proposes to continue his experiments with these products for the purpose of endeavouring to determine their precise composition. Meanwhile, he states that both oils are of the highest quality, and that, in his opinion, they will be found to serve every purpose for which oil of turpentine (French or American) is used. They compare favourably even with the French oil, which is the highest quality in the market.

The resin or colophony which is left after distilling off the oil from the two samples is of good quality, and would be available for all purposes for which ordinary resin is used.

There appears to be no reason why India should not obtain whatever turpentine is required in the country from native sources. Professor Armstrong hopes, later on, to furnish a more detailed report in regard to the composition of the oils obtained from these two turpentines.

F. A. ABEL,
Secretary and Director,
Imperial Institute, London.

Deterioration of Indiarubber by keeping.

We are asked to publish the following copy of a letter dated the 11th May 1896, from the Reporter on Economic Products to the Government of India, to the Inspector-General of Forests, Simla:—

“Replying to your demi-official dated 24th ultimo, on the subject of the Assam rubbers, I am glad to find that you underestimated them. That gives a better token of the future, than if you had gone to the other side. As to the want of uniformity in Carritt and Co.’s valuation, so much depends in the eyes of brokers on external characters, that the sample that had got a little more oxidised through more direct exposure to air than another would at once get a lower price assigned to it. It is wonderful how rapidly indiarubber in its crude state suffers. Some of our samples in the Museum have become liquids, devoid of all elasticity. This, I think, should give the practical suggestion that the sooner rubber leaves the producer’s hands and is taken over by the purchaser the better. No consignments should be delayed in India.”

“But besides oxidization there are many other ways by which one parcel drawn from identical trees and prepared by the self-same process will fetch a lower price. But I think the Assam Conservator told us that the samples were obtained from several recognized races of the rubber tree. So that there may be a botanical reason for the variation in the valuation, I am promised botanical samples of each form, and will, I hope, soon be in a position to express an opinion upon this feature. I hope Assam may be able to furnish us with larger samples. We could easily find willing buyers, as there is a distinct demand for Assam rubber.”

 VI.-EXTRACTS, NOTES AND QUERIES.

The Indian Forest Department and Coopers Hill

In the December number of the *Indian Forester* an article appeared in which the claims of the higher grades of Forest officers to additional pensions was discussed. It was argued that the position of the Inspector-General was analogous to that of a Chief Engineer in the Public Works Department, and that Conservators corresponded to Superintending Engineers; and that, consequently, Conservators were entitled to the extra pension of Rs. 1,000 a year granted to the latter. The argument was based on the Civil Service Regulations and the Prospectus issued officially for the Coopers Hill College course. In the former, section 714 stated that an additional pension of Rs. 2,000 might be allowed, for approved service, to Chief Engineers and the Director-General or Deputy Director-General of Telegraphs; and one of Rs. 1,000 to Superintending Engineers, P. W. D., and Directors in the Indian and Indo-European Telegraph Departments. In the Coopers Hill *Calendar* for 1894-95 (page 20) these particular pensions were also set forth as still sanctioned, and on page 125 the following paragraph appeared: "The more favourable pension rules have recently been extended to Forest officers appointed from England, *who are thus placed on an equality with Public Works officers appointed from Coopers Hill College*. Any Forest officer who has rendered not less than three years' approved service, as head of his department, has also been made eligible for an extra pension of Rs. 1,000 a year." As Conservators are heads of the Forest Department in the provinces in which they serve, it was reasonable to contend that they were entitled to this extra pension of Rs. 1,000, and that the Inspector-General was eligible for the Rs. 2,000 pension, as he was on an equality as regards pay and position with a Chief Engineer or the Director-General of Telegraphs. If this were not the case then the "equality with Public Works officers" was obviously unreal. The publication of the article in the *Forester* had rather startling results. Sir Alexander Taylor, Principal of Coopers Hill College, wrote out that "the criticism overlooked the fact that the concession, granted for special reasons, whereby Chief Engineers were eligible for an additional pension of Rs. 2,000, was withdrawn by Lord Kimberley's despatch of 21st September 1893; and that under the operation of that despatch, from the end of 1893, the same orders govern the award of pensions to recruits thereafter entering from Coopers Hill College, either the Public Works, the

'Telegraph, or the Forest Department.' This was the first time that any public mention had been made of this despatch, and the *Forester* returned to the charge. It pointed out in its April number that though 2½ years had elapsed since the despatch was sent out, no alteration had been made in para. 715 of the Civil Service Regulations; and it expressed the belief that Public Works officers were ignorant that the concession to Chief Engineers had been withdrawn. Curiously enough this important announcement conveyed in Sir Alexander Taylor's letter apparently escaped the notice of Public Works officers, for no comments upon it appeared in the press. Now, however, we trust that the matter will be taken up. The Government of India have to explain to the services and the public generally why the Civil Service Regulations were not altered immediately after the despatch of September 1893, and the India Office in its turn has to explain why the *Coopers Hill Calendar* for 1894-95 "published by authority" was allowed to contain paragraph 12, page 20 with its delusive promises. Putting the Forest Department aside, both these official publications contain misleading statements as regards the Public Works, for Chief Engineers appointed since the end of 1893 are not eligible for the extra pension of Rs. 2,000. The Government may possibly point to a Resolution in the Financial Department, dated June 22nd 1895, in which certain officers were enumerated, in eleven departments, as eligible for the extra pension of Rs. 1,000. But nothing whatever was said about the withdrawal of the Rs. 2,000 pension from Chief Engineers, though the preamble contained among other things the line: "Read—Despatch from the Secretary of State for India, No. 188 (Financial), dated 21st September 1893." It had taken 21 months even to mention it as having been "read," but its contents were kept strictly secret save in the Secretariats, why or wherefore we cannot attempt to say. If it had not been for the article in the *Indian Forester* and Sir Alexander Taylor's action thereon it would probably have remained secret until some unfortunate applicant had come to claim the pension he believed to be his. As it is, Sir A. Godley has given the substance of the despatch in a letter which will be found in another column which we recommend to the attention of the rank-and-file of the Public Works Department. Parents and guardians who put their trust in the *Coopers Hill prospectus* should also study it.

As regards the Forest Department, there is one important statement in Sir A. Godley's letter. It is as follows: "The Forest Regulations for the examination of 1894 applied to recruits entering Coopers Hill College after that examination; and selected Forest candidates of 1894 and subsequent years will undoubtedly—so long as those orders stand—enjoy the same pension rules as their contemporaries of the Public

Works Department. It has not yet been settled how far a Conservator of Forests, belonging to the 1st or other grade, shall be treated as head of his Department. When that has been decided, the decision will be published in India and will be embodied in the Civil Service Regulations." We trust that Conservators will be held to be entitled to the extra Rs. 1,000 pension, but even if this measure of justice is granted the grievances of the Department will by no means have been redressed. A short history of the Forest case will best explain the position. In 1874, when the inadequacy of the pension rules could no longer be ignored, the cases of the Public Works, Telegraph and Forest Departments were treated together. In August of that year a joint Memorandum was prepared by Messrs. Molesworth, Cappel and Brandis—all of them, by the way, Knights in after years. The Government of India did not accept their recommendations, but suggested that the proposals should be revised and brought forward again. This was done eventually in 1882, when a comprehensive memorandum was submitted by Sir D. Brandis who, it is well known, took the lead in the matter. Up to that time the proposals had been made and considered jointly for the three Departments concerned; but, for reasons not divulged, the P. W. D. then took up their own case separately, with the result that in April 1884 a Government Resolution was published granting improved ordinary retiring pensions to Civil Engineers, and a scale of special additional pensions for Chief and Superintending Engineers (Rs. 2,000 and Rs. 1,000). Some months afterwards the orders were extended to the Telegraph Department—the Forest Department was left out in the cold. Covenanted foresters throughout India at once memorialised the Secretary of State, pointing out (a) that His Lordship has already stated that Forest and P. W. D. officers occupied a closely analogous position, and that he had granted to the former many concessions as to service, &c., previously given to the latter; (b) that Forest officers were of the same social position, selected in the same manner, and trained at the same College as Public Works officers, and performed duties of equal importance; and that all should, as a matter of equity, obtain the same rules of service; (c) that recruitment for the Forest Department would be injuriously affected unless the P. W. D. rules were applied to it; and (d) that the hard life and unhealthy surroundings of the Forest officer compelled the average man to retire earlier than other officials. No notice was taken of the memorials. The Government were awaiting the report of the Public Service Commission, and that body eventually strengthened the case of the memorialists by stating that "the conditions of service as to leave and pensions should be assimilated to those of the Imperial Branch of the Public Works Department." After nine long years came a Resolution

granting to the Inspectors-General of Forests, present and future, an extra pension of Rs. 1,000, thus placing the occupant of that appointment on a level with present Superintending Engineers. In 1895, yet another Resolution appeared extending to Covenanted Forest officers the better scale of ordinary *retiring pensions laid down in Article 712 of the Civil Service Regulations*; and finally in March of the current year was published a despatch from the Secretary of State in which the balance of the demands made by the Forest officers was rejected. These were that the additional pensions (enjoyed by *present* Public Works and Telegraph officers), corresponding to Rs. 2,000 to the Inspector-General and Rs. 1,000 to Conservators of the 1st and 2nd grades, should be granted as a matter of right. Lord George Hamilton in his despatch to the Government of India said:—"You rightly state that such a concession (special pensions) has been repeatedly recommended by the Government of India since 1885; but it has been more than once pointed out, in reply, that privileges granted for exceptional reasons to one Department need not, therefore, be granted to another Department which in many respects was on a different footing." We have failed to find mention of the "exceptional reasons" here alluded to; in the 1884 despatch the additional pensions were authorised simply "as rewards for approved service"—there is certainly nothing "exceptional" in this.

The effect of this long-standing agitation is that the home-appointed Forest officers continue to smart under what they know the Government of India agree with them in considering an injustice. Recruitment for the Forest Branch at Coopers Hill has been so injuriously affected that occasionally sufficient students have not qualified for the appointments offered, and the India Office has been forced to take some of the failures. The physique of some of the recruits has been so poor that special reports on the men sent out are now regularly made by Local Administrations at the request of the Government of India. The India Office may "decline to reopen the question," to quote the despatch of last March, but it will have to be reopened all the same, for questions will be put in Parliament and the case will be fought out to the end. The Secretary of State, in reply to Sir Richard Temple, pledged himself to lay the correspondence on the table of the House, when complete, and when this promise is kept the true facts will be revealed. Meanwhile it may be asked who was responsible for the misleading statements in the *Coopers Hill Calendar* of 1894-95 and in the Civil Service Regulations.—(*Pioneer*, June 12th, 1896.)

The Natal Forest Department.

The '*Révue Agricole*' of Mauritius says that the Natal Forest Department has practically disappeared. It was started in 1891

on the report of M. Fourcade, an ex-student of the French Ecole Polytechnique now in the Cape Forest Department. He was succeeded for three years by a distinguished forester from the Grand Duchy of Baden, Herr Schöpflin, but it would seem that the Natal Government has failed to keep him and he has returned to Germany. The *Révue* goes on to say "it is to be feared that if the State has not yet again taken its forests in hand, which have already been so severely damaged by the natives, they will soon disappear. It would seem that one might well apply to Natal the words which were used nine years ago by a distinguished authority before the Royal Colonial Institute "the British Colonies are only playing with their forest question."

The Quality of Pine Timber.

The difference in the quality of timber, according to the soil and situation in which it is grown, is so great that the value of any given species as a timber tree can scarcely be gauged with any degree of accuracy, unless we are in possession of full information as to its behaviour under varied conditions. So far as our indigenous species go, we are pretty well posted up in respect to the quality we may expect to find associated with our principal soils, but with introduced and less known trees we have still a good deal to learn. One fact is clearly demonstrated, however, and that is that luxuriance or rapidity of growth is usually an accompaniment to strength and elasticity of timber, and that these qualities are by no means invariably associated with durability. This last quality is probably the one most desired in pine timber, for the extended use of iron for purposes where great strength is required, renders its presence in timber of less importance now than formerly. The relation between rate of growth and durability is nowhere more marked than in coniferous timber. This chiefly arises from the great difference between the spring and autumn zones of the wood, or "annual ring." These two zones are easily recognised by the naked eye, owing to their distinct shades of colour and general appearance, the spring zone being light and ragged on the sawn surface, while the autumn zone is much darker, and has a clearer and more polished appearance on an unplanned transverse section. Under the microscope the difference in structure is more marked, the spring wood being a mere skeleton of thin cell walls, while the autumn wood shows cells with greatly thickened walls and narrow cavities or *lumina* between them, forming not only heavier and harder, but also more durable wood than that in the spring zone. It is principally the proportion of autumn wood contained in the annual rings which determines the durability of the timber, and this proportion is greatly, though not entirely, dependent upon

the conditions under which the annual growth is made. Until the exact causes which are responsible for these two distinct zones are clearly defined, we are unable to say exactly how the formation of autumn wood is affected by these conditions, the generally accepted opinion is that what the large growth is deferred in spring and continued in autumn, the greater is the proportion of autumn wood. Of equal, if not greater, importance than the period of growth, however, is its rate and the nature of the soil. The better the latter, the better other things being equal, is the quality of the timber, but the latter, we have already said, is usually inversely proportional to the rate of growth. In pine timber of good quality the autumn wood zone occupies from one-third to one-half of the whole ring, where the breadth of the latter does not exceed one-eighth of an inch. Where this breadth is exceeded, however, we usually find the breadth of the spring zone to increase more rapidly than that of the autumn zone. This being the case, it is evident that slowly grown, but otherwise favourably produced, timber contains a larger proportion of autumn wood than that from a tree in which the spring zone occupies the lion's share of the annual rings, and will also be of a more homogeneous nature than timber in which the relative breadths of these two zones show greater divergence. It is not asserted, however, that slowly grown timber is necessarily of good quality, as this latter depends a great deal upon its freedom from knots and general uniformity of texture. For practical purposes only three-fourths or so of the stem are available for running out into deals or battens, the sapwood being discarded for all the more important descriptions of sawn timber. In a tree which grows rapidly in diameter during the first thirty or forty years, the most valuable part of the stem is usually occupied by timber consisting of broad rings containing coarse knots, as rapid diameter growth in the early stages means comparatively unrestricted branch growth. Not only this, but the first few rings from the pith are always deficient in autumn wood, and in such a tree it is not until the sapwood is approached that we come to really clean and well-formed timber.

With the above facts before us it is not difficult to see the advantage of rearing pine timber in close plantations in which the want of space prevents undue development of stem diameter and branches in the early stages. We notice that Mr. Mackenzie in his paper on "Practical and Profitable Forestry," expresses his want of faith in what he calls the German theory of growing pine timber. The German method of growing pine is based upon the requirements of the timber consumer for wood of good quality. What these are may be seen from the specifications of different qualities of Swedish redwood, given on page 8 of the Special Issue of the *Journal*. Freedom from large knots is insisted upon in all the higher classes, and this absence of knots

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is just what the majority of our British grown timber lacks, for the simple reason that thinning begins in our plantations before the lower branches are thoroughly choked off, and the best part of the stem is rough and coarse in consequence. (A. C. FORBES, in *Timber Trades Journal*.)

Too much Fire-protection in Burma.

No. 4.

The following remarks appear in para. 26 of the report on Forest Administration in the Pegu Circle, 1894-95 :—

“ The Divisional Officer, Tharrawaddy, states as follows :—

(a) That fire-protection permits the formation of humus and prevents that burning of the soil into red bricks which is such a feature in unprotected forests where the soil is argillaceous.

(b) That this humus forms a better seed bed, and that seeds are not washed down into gullies by the rain as is the case when the soil is baked and left exposed.

(c) That teak, however, as its seed takes longer to germinate than the seeds of fast growing grasses, bamboos, &c., fares badly in the struggle for existence and is kept back by being over-topped and is often suppressed.

(d) That teak seed is less affected by fire than the seed of most of the inferior species, and is as a rule but little damaged by the ordinary ground fires, and is therefore in unprotected forests often left in undisputed possession of the soil.

(e) Teak seedlings also suffer less from fire than the seedlings of other species. They may be burned down, but will spring up again year after year until they are strong enough to resist fire. It is probable, however, that a great deal of our hollow timber is due to this burning. Cutch, *pyinkado* and many other seedlings, however, do not survive a burning.”

Again, para. 50, Report on the Forest Administration in the Western Circle, 1894-95.

“ Teak is generally associated with bamboos, *the cover of which prevents the germination of teak seed*, or soon suppresses seedlings which have germinated.”

Criticism on the above.

(a) Theoretically, of course, fire-protection, if successful, should promote and permit the formation of humus. Unfortunately, as far as I have been able to observe in the Prome Division, it does not do so at all. Soon after the commencement of the rains, I noticed last year in the Chaungzauk reserve that whiteants (?) eat up all the leaves and dead grasses that were lying about; in other parts of this Division, too, I have noticed that decaying vegetation, sticks, logs, &c., are permeated with whiteants and earth-worms, &c. The result is not humus, though I have no doubt that much matter is worked into the soil, which is thereby improved. In parts of the Chaungzauk reserve which have been successfully fire-protected for 16 years now, though the forest is moister than the parts which have not been protected, I have failed to notice that humus has been formed.

The absence of fires of course prevents the hard baking of the soil into bricks.

(b) Were humus present, naturally there would be a better seed bed and one too from which the seeds would bear less chance of being washed away at the first burst of the monsoon, as is too often the case. Fire-protection does tend to prevent this washing away of the seed; but my reason for making this statement is a different one to Mr. Slade's, with whom I totally disagree about the formation of humus, at least as far as the Prome Division is concerned. Fire-protection prevents the leaves, grass, &c., being burnt, and as they are not eaten and worked into the soil until after the first burst of the monsoon, the seeds find a lodging amongst these leaves, grasses, &c., and are retained, and germinate even under a thick canopy of bamboos (vide second quotation from Western Circle Report quoted at the beginning of this memo). Outside fire-traced areas the soil is baked hard and the leaves, &c., burnt; the sequel is that the first rain rushes down, bearing most of the seed before it into the nullahs, as it finds no lodging except here and there in depressions and cracks in the soil; hence most of the seed is lost.

(c) I agree with Mr. Slade's remarks under this subhead.

(d) Ditto.

It is a very noticeable fact in this division, that, outside fire-traced areas, where the canopy is very light owing to the jungle being yearly burnt over, the natural regeneration of teak is better than in the fire-traced areas. Again, inside such areas regeneration of all light-demanding species, such as teak, *pyinkado* (*Xylia dolabriformis*) and cutch, is infinitely better in *myinwa*, (*Dendrocalamus strictus*) which flowers sporadically, than in *kyathauung* (*Bambusa polymorpha*) forest, where the shade is denser and the light is not let in by sporadic flowering.

The significance of this is emphasized by the fact that *kyathaung* grows on moister and better soil than *myinwa*, where the seedlings would have, *cæteris paribus*, a better chance of flourishing.

(e) I agree with the first part of this subhead ; with reference to the last paragraph, however, I cannot agree. Cutch and *pyinkado* seedlings are very often, generally I might say, burnt down ; but, they as a rule spring up again the next year, sending out stronger shoots than before. This is especially the case with cutch, though it is true, but to a less extent with *pyinkado*.

F. J. BRANTHWAITE.

Sleepers for Ceylon Railways.

The creosoted Baltic fir sleeper, with which our railways are principally laid, is a more satisfactory sleeper, as regards length of life and first cost, than the native hardwood sleeper. The former, notwithstanding having been first imported from the north of Europe to England, and, after sawing and creosoting, again shipped to Ceylon, cost only Rs. 3.30 each, whereas the native hardwood sleeper grown in our forests, and supplied to this Department, cost, without creosoting Rs. 4 each, and their respective average lives are as eight to five. The defect in the Ceylon native wood sleeper is "dry rot," the only exception being satinwood and malilla, neither of which is now obtainable for sleepers. I have tried na (ironwood), palu, kahata, mi, doon, and many other Ceylon timbers, some of which had to be taken out of the road after eighteen months, owing to dry rot, while others have lasted as long as five to seven years.

Of Rs. 10,000 hardwood sleepers supplied for the construction of the Bentota extension, at Rs. 4 each, and said to be "doon," there is not one in the road now, some of them were completely rotten in twelve months, and out of the whole number none had a life of five years.

We shall always require hardwood sleepers for our sharp curves, owing to their greater resistance to crushing, and giving a better hold for the fastenings. Australian hardwood sleepers have been tried, *viz.*, red and blue gum and karri. The former had a

life of from twelve to fifteen years ; the latter has not been long enough in the road to fairly judge of its life as a sleeper.

I have not had an opportunity of trying the Australian " iron bark," but from the fact that iron-bark sleepers are now being shipped to England in large quantities, I would infer that they are both fairly cheap and have a good reputation.—(*Ceylon Forester.*)

Forest Fire Legislation in the United States.

It is admitted by all who have studied the needs of forestry in this country that no application of rational forest management can be expected until forest property is better protected against fire.

Circular No. 10 of this Division stated the principles that must underlie effective forest fire legislation, and has, it is believed, been influential in shaping the measures which were enacted in Wisconsin and Minnesota during the past year. The object of the present circular is to call attention to these more recent forms of legislation and to briefly summarize all existing acts in force in the different States for the protection of forests from fire.

The *Minnesota* law, which is modelled after the *New York* and *Maine* laws—pioneers in rational forest fire legislation—is believed to be the most complete, and has been quoted entire, the provision of the *Maine* law being given at some length. All of these recognise the necessity of intrusting the enforcement of the law to some responsible officer. It is hoped that other States will find both incentive and assistance in these advanced measures for the revision of their own forest fire legislation.

The *Minnesota* law is as follows:—

AN ACT TO PROVIDE FOR THE PRESERVATION OF FORESTS OF THIS
STATE AND FOR THE PREVENTION AND SUPPRESSION OF FOREST
AND PRAIRIE FIRES.

Be it enacted by the Legislature of the State of Minnesota:

SECTION 1. The State auditor shall be forest commissioner of this State, and his orders shall be supreme in all matters relating to the preservation of the forests of this State and to the prevention and suppression of forest and prairie fires as hereinafter provided. The supervisors of towns, mayors of cities, and presidents of village councils are hereby constituted fire wardens of their respective towns, cities, and villages in the State, and the chief fire warden may appoint as fire wardens such other persons as he may deem necessary living in or near to unorganized territory in this State, whose districts, to be known as fire districts, he may determine.

SEC. 2. The aforesaid forest commissioner shall appoint a competent deputy to be known as chief fire warden, who, from personal experience, is familiar with the conditions of the forest and methods by which fires may be controlled. Said chief fire warden shall receive a salary of twelve hundred (\$1200) dollars per year, and shall hold his office during the pleasure of the forest commissioner. He shall represent the authority of the forest commissioner, and it shall be his duty to enforce the provisions of this act throughout the State.

SEC. 3. The chief fire warden shall have general charge of the fire warden force of the State, and shall have authority to mass such fire warden force as may be available at any special point to suppress fires. In case the fire warden force of any locality is deemed by said chief fire warden inadequate to prevent or suppress forest or prairie fires he may appoint temporarily needed fire wardens, whose duties and authority shall be the same as herein given to town supervisors acting as fire wardens. He shall properly divide into fire districts all unorganized territory in this State and appoint competent fire wardens therein; he shall cooperate with any police or military force of the United States Government which may be detailed to guard the national domain from fire; he shall investigate the extent of the forests in the State, together with the amounts and varieties of the wood and timber growing therein, the damages done to them from time to time by forest fires and the causes of such fires, the method used, if any, to promote the regrowth of timber, and any other important facts relating to forest interests which may be required by the forest commissioner. The information so gathered, with suggestions relative thereto, shall be included in a report to be made by him annually to the forest commissioner.

SEC. 4. The forest commissioner shall provide and officially sign an abstract of the penal laws of this act, with such rules and regulations in accord therewith as he may deem necessary, and on or before the first day of April of each year he shall forward as many copies as he considers needful to the chairman of each town board of supervisors and presidents of villages, to the forest fire wardens that he has appointed and to all railroad companies and to the chairman of each board of county commissioners in this State, and it shall be the duty of said fire wardens to post up such abstract as warning placards in conspicuous places in their respective districts, and it shall be the duty of the country commissioners of each county to cause the said abstract to be published in at least three issues of the official paper in their respective counties during the fire-dangerous season of each year, which shall be reckoned from the 15th of April to the 1st of November.

SEC. 5. During a dry and dangerous season, when forest and prairie fires are prevailing or are liable to break out, the chief fire warden shall use such means under his command as he may deem necessary to prevent or suppress such fires, and his expenses shall

be paid by the State, which expenditures in one year shall not exceed five thousand dollars, to be paid for out of the general revenue fund, upon the order of the forest commissioner.

SEC. 6. It shall be the duty of each fire warden to take precautions to prevent the setting of forest or prairie fires, and when his district is suffering or threatened with fire, to go to the place of danger to control such fires, and each forest fire warden shall have authority to call to his assistance in emergencies any able-bodied male person over eighteen years of age, and if such person refuses, without reasonable justification or excuse, to assist, or if any fire warden refuses or neglects to perform the duties assigned him in this act, such officer or person shall be deemed guilty of a misdemeanor, and shall upon conviction thereof be punished by a fine of not more than one hundred (\$100) dollars or imprisonment in the county jail not to exceed three (3) months.

SEC. 7. The chief fire warden and the several fire wardens created by this act shall have authority to enforce the provisions of this act, and it shall be their duty to cooperate with the fire warden of any adjoining district, and in the absence of such fire wardens to direct the work of control and extinguishment of forest or prairie fires in such district, and to arrest without warrant every person violating any provisions of this act, and to forthwith take the offender before a magistrate and make complaint against such person. The chairmen of boards of township supervisors, presidents of villages, and fire wardens appointed by the chief fire warden shall inquire into the cause of each forest or prairie fire within their districts and shall report the same to the chief fire warden and the methods used to control or extinguish such fires and the amount of property destroyed and the number of lives lost, if any, and report such other facts in regard to said fires as said chief fire warden may require. During the more dangerous season of the year the chief fire warden may require frequent reports from the chairmen of township boards, or in unorganized towns from fire wardens appointed by the said chief fire warden as to condition of forest and prairie fires and as to what is being done to control the same.

SEC. 8. Each fire warden shall receive for his actual services rendered under this act two (\$2) dollars per day, two-thirds of which shall be paid by the county where such service is performed, and one-third by the State; and any employee engaged in like service shall receive at the rate of one and fifty one-hundredths (\$1.50) dollars per day, and said expense shall also be paid, two thirds by the county where such service is rendered, and one-third by the State, as hereinafter provided, but no payment shall be made to any claimant under this act until he shall have presented an itemized account and made oath or affirmation that said account is just and correct, which account shall be approved by the board of township supervisors, and shall be audited by the county commissioners, when satisfied of the justice of the claim, and left on file with the county auditor; in case of unorganized town-

ships, the board of county commissioners alone shall approve and audit such accounts. The county auditor shall thereupon issue to each claimant his warrant upon the county treasurer for the entire sum to which such claimant is entitled, and the treasurer shall pay the same. Such county auditor shall transmit the original oath and copy of the warrant to the State auditor, who shall audit such claim, and one-third thereof shall be paid out of the State treasury from the general revenue fund by warrant issued by the State auditor upon the State treasury in favor of the county thereof paying the same, and forward the same to the auditor of said county: *Provided*, That no fire warden shall be paid, in any one year, for more than ten (10) days' service in extinguishment and preventing forest or prairie fires, nor for more than five (5) days' service in each year in posting notices and making the reports required by this act; nor, in the aggregate, for more than fifteen (15) days' service of whatever character, in any one year; nor shall any one person employed by fire wardens to assist in extinguishing or preventing forest or prairie fires be paid for more than five (5) days of such service in any one year. No county shall expend more than five hundred (\$500) dollars of public money in any one year under this act.

SEC. 9. Any person who wilfully, negligently, or carelessly sets on fire, or causes to be set on fire, any woods, prairies, or other combustible material, whether or not on his own lands, by means whereof the property of another is injured or endangered, or any person who wilfully, negligently, or carelessly suffers any fire set by himself to damage the property of another, is guilty of a misdemeanor and shall be punished by a fine not exceeding one hundred (\$100) dollars, or by imprisonment in the county jail not exceeding three months. Any person who maliciously sets on fire, or causes to be set on fire, any woods, prairies or other combustible material whereby the property of another is destroyed and life is sacrificed, shall be punished with a fine of not over five hundred (\$500) dollars, or be imprisoned in the State prison for a term of not over ten (10) years, or both such fine and imprisonment.

SEC. 10. Any person who shall kindle a fire on or dangerously near to forest or prairie land and leave it unquenched, or shall be a party thereto, and every person who shall use other than incombustible wads for fire-arms, or who shall carry a naked torch, fire brand or other exposed light in or dangerously near to forest land, causing risk of accidental fire shall be punished by a fine not exceeding one hundred (\$100) dollars or imprisonment in the county jail not exceeding three (3) months.

SEC. 11. Every person who shall wilfully or heedlessly deface, destroy, or remove any warning-placard posted under the requirements of this act shall be liable to a fine not exceeding one hundred (\$100) dollars for each such offense, or imprisonment in the county jail not exceeding three (3) months.

FOREST FIRE LEGISLATION IN THE UNITED STATES

SEC. 12. It shall be the duty of all railroad companies operating any railroad within this State to use efficient spark arresters on all their engines and to keep their right-of-way to the width of fifty (50) feet on each side of the center of the main track cleared of all combustible material and safely dispose of the same within said limits of their right of way between the 15th day of April and the 1st day of December. No railroad company shall permit its employees to leave a deposit of fire or live coals, or hot ashes, in the immediate vicinity of woodland, or lands liable to be overrun by fires, and where engineers, conductors, or trainmen discover that fences or other materials along the right-of-way or woodland adjacent to the railroad are burning or in danger from fire, they shall report the same promptly at the next telegraph station that they may pass. In seasons of drought railroad companies shall give particular instructions to their employees for the prevention and prompt extinguishment of fires and they shall cause warning-placards furnished by the forest commissioner to be posted at their stations in the vicinity of forest and prairie grass lands; and where a fire occurs along the line of their road they shall concentrate such help and adopt such measures as shall be available to effectively extinguish it. Any railroad company wilfully violating the requirements of this act shall be deemed guilty of a misdemeanor and be punished by a fine not exceeding one hundred (\$100) dollars for each such offense, and railroad employees wilfully violating the requirements of this section shall be guilty of a misdemeanor and be punished by a fine of not less than five (\$5) dollars nor more than fifty (\$50) dollars. But this section shall not be construed to prohibit or prevent any railroad company from piling or keeping upon the right of way cross-ties or other material necessary in the operation or maintenance of such railroad.

SEC. 13. It shall be the duty of each and every owner of thrashing or other portable steam engines to have efficient spark arresters on their engines at all times when in use, and no person in charge of any thrashing engine shall deposit live coals or hot ashes from his engine in any place without putting them out or covering them with at least three inches of earth before leaving them. All persons violating the provisions of this section shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not less than five (\$5) dollars nor more than fifty (\$50) dollars.

SEC. 14. Nothing in this act shall be construed as affecting any right of action for damages.

SEC. 15. Woodland territory within the terms of this act shall be construed to mean bodies of forest and brush land.

SEC. 16. All moneys received as penalties for violating the provisions of this act shall be paid into the county treasury of the county wherein the offense occurred, to be known as the county fire fund, and used under the direction of the county board in

defraying the expenses of enforcing the provisions of this act within such county.

SEC. 17. The forest commissioner shall annually on or before the first day of December make a written report to the governor of his doings in respect to the duties herein assigned him, together with an itemized account of the expenses incurred in carrying out the provisions of this act, which report shall include such statistics and facts as he has obtained from the chief fire warden and from the several fire wardens of the State and from other sources, together with his suggestions relative to the preservation of the forests of the State and to the prevention and extinguishment of forest and prairie fires.

SEC. 18. All acts and parts of acts inconsistent with this act are hereby repealed.

SEC. 19. This act shall take effect and be in force from and after its passage.

Approved April 18, 1895.

The *Wisconsin* law (Chapter 266, Laws of 1895) is similar in general character to the Minnesota law, except that the chief clerk of the State land office and his deputy are made State forest warden and deputy forest warden, respectively, without additional salary. Towns are limited to \$100 per year expenditure in extinguishing fires.

The *Maine* law (Chapter 100, Public Laws of 1891) makes the State land agent the forest commissioner. The selectmen of towns are made fire wardens and their duties are to post copies of the law in conspicuous places, and to superintend the work of extinguishing fires. They are empowered to call upon any person for assistance, and a refusal makes the party liable to \$10 fine. The county commissioners in counties where there are unorganized places may appoint not to exceed ten fire wardens. No town shall expend, for extinguishing fires, more than 2 per cent. of its valuation for purposes of taxation. Anyone who neglects to extinguish a camp fire is liable to a fine not exceeding \$10⁰⁰ or imprisonment in the county jail for one month, or both. Non-combustible wads must be used by hunters. Municipal officers (and county commissioners in unorganized places) shall make strict inquiry into the causes of fires within wooded lands, and prosecute the offender without delay. Town selectmen shall, where a forest fire of more than one acre has occurred, report to the forest commissioner the extent of fire and amount of loss, and the measures found effective in subduing fire, for which purpose blanks shall be furnished by the forest commissioner.

Railroad companies are required to have their employees burn or cut and remove all grass, etc., from their right-of-way once a year; to use spark arresters on their locomotives; to refrain from depositing live coals, fire, or ashes on their track; and to report fires along right-of-way at the next stopping place that is a telegraph station. Railroad companies are held liable

for all damage to forest growth by any person in their employ during road construction. During construction of such roads through woodlands, abstracts of the laws relating to forest fires shall be posted along the roadway at distances of 200 feet. Anyone so employed who fails to extinguish a fire made by him is liable to a fine not exceeding \$500 or imprisonment not exceeding sixty days, or both, and it is made the duty of all persons having charge of men in such railroad construction to see that the provisions of this act are complied with, any negligence subjecting them to the punishment above named. Violations of this act by railroads are punishable by a fine of \$100 for each offense. The forest commissioner shall encourage an interest in forestry in the public schools, and shall prepare circulars of information giving advice for the care of woodlands. He shall have copies of this chapter and all other laws of the State relating to forest fires printed and freely distributed to the selectmen of all the towns of the State, who shall post them up in schoolhouses, sawmills, logging camps, and other places, and to forest owners who may post them at their own expense. Anyone defacing or destroying such notices is liable to a fine of \$5.

Colorado.—Chapter 54 [Mill's Annotated Statutes (1819)] creates the office of forest commissisner. The forest commissioner shall cause all woodlands owned by the State to be located and recorded, make and publish reasonable rules and regulations for the prevention of trespass upon said lands, for the prevention and extinguishment of fire thereon, and for the conservation of the forest growth. He shall, so far as possible, promote the gradual extension of the forest area, encourage the planting of trees, and preserve the sources of water supply, but shall not interfere with the use of timber for domestic, mining, or agricultural uses. On or before December 15, annually, he shall report to the governor his official action during the preceding year, and such information as may be useful in preserving the forest and maintaining the supply of water.

County commissioners and road overseers shall act as conservators of woodlands in their respective localities. They shall encourage the planting of trees along watercourses, irrigating ditches, and in other proper places, but shall incur no expense, except in cases of emergency, unless by direction of the State forest commissioner. It is made the especial duty of all forest officers to exercise the utmost care and vigilance in the prevention and extinguishment of fires likely to endanger the forest growth, and to apprehend any person who may be guilty of causing such fire.

Any person refusing to aid in extinguishing fire shall be fined \$25 to \$100. All forest and peace officers are required to arrest and prosecute trespassers on State woodlands. District officers shall be subject to county officers and both shall make annual reports to the State forest commissioner. Road overseers shall receive \$3 per day and county commissioners the same per diem as is allowed for their services as county commissioner,

No county shall expend more than \$100 per year under this act.

No lumberman can serve as forest commissioner. The law also provides premiums for planting trees along roads and irrigating ditches.

In *New York* a forest fire law was passed in 1885 as a part of a comprehensive forestry measure, viz, "An act to establish a forest commission and to define its powers and duties and for the preservation of forest." It was the first State to establish the principle of creating officers responsible for the execution of the law, and organizing an army of fire wardens throughout the State.

In 1895 (Chapter 974, Session Laws 1895, approved June 7, 1895) a change in the administrative features of the commission was made, but the duties of the new "Board of Fisheries, Game, and Forests" as far as the enforcement of the regulations against forest fires are concerned, remain the same; the chief forester being charged with this duty, with the fish, game, and forest wardens acting as fire wardens on the State lands and the supervisors of towns outside of State lands. The general features of the bill are the same as in the Maine law. The penalty for wilfully or negligently setting fire to any waste or forest lands belonging to the State or to another person is a fine of \$50 to \$500, and liability to parties injured in full damages.

The law is elaborate in detail, authorizing in addition to the fire service as outlined above, the establishment of the State forest reserve, the Adirondack Park, and deer parks in the Catskill region; and including very full regulations for the protection of fish and game.

Pennsylvania from early colonial times has had laws for the protection of forests from fire. The law of March 13, 1895, creates the office of commissioner of forests as a part of the department of agriculture. The secretary of agriculture of the State is required to enforce all laws designed to protect the forest from fires and from all illegal depredation, report conditions and extent of forest lands, statistics of timber cut, etc. The act of June 2, 1870, makes it the duty of the county commissioners in certain counties "to appoint persons under oath whose duty it shall be to ferret out and bring to punishment all persons who wilfully or otherwise cause the burning of timber lands, and to take measures to have such fires extinguished where it can be done; the expenses thereof to be paid out of the county treasury." * * * Act No. 173 of the session laws of 1887 as amended by act of May 14, 1891, in addition to providing a bounty for tree planting, prescribes as penalty for * * * kindling fire in any forest land without consent of the owner * * * or permitting fire to spread to the lands of another, a fine of \$100 and costs for each offense.

The *New Hampshire* law (Chapter 44, Laws 1893) establishes a forestry commission, makes the selectmen of towns fire wardens, and authorizes the county commissioners to appoint fire wardens

where no town organizations exist. Fire wardens to be paid by the town or county. Chapter 110, Laws 1895, authorizes the forest commission to appoint a suitable number of fire wardens, upon the application of owner of a tract of forest land where no town organization exists for said tract, and limit the term of employment, fix compensation, etc., one-half the expense to be borne by the owner and one-half by the county.

The above quotation and abstracts represent the most advanced position in forest fire legislation in the United States. Following is a summary which contains citations to date of revised statutes and codes, with chapter and section, of the laws of all the States and Territories bearing on forest fires :

Summary of Forest fire laws.

State.	Edition of Code.	Title.	Chapter.	Section.	Penalty.
Alabama.....	C. C. 1896	.....	.....	4226-8	Fine \$10-200 ; if turpentine forest. \$100-\$1,000, or hard labor for not more than 12 months.
Arkansas <i>a</i>	S & H's D. 1894.	.....	48	1580-4	Fine \$25-\$300, or jail 10 60 days. Liable for double damages.
California <i>b</i>	P C. 1886.	10	.....	384	Fine not more than \$1,000, or jail not more than 1 year, or both.
Colorado <i>c</i> !.....	Mills G. S. 1891.	.....	36	1414-15 17-18	Fine \$50-\$300, or jail 15 days 3 months, or both. If on State lands, \$50-\$500 or 20 days-6 months.
Connecticut <i>d</i>	G. S. 1888.	19	99	1458 1460-2	Fine \$20-\$300, or jail 2-6 months, or both. Fine \$1-\$50, or jail not more than 30 days.
Delaware <i>e</i>	Vol. 18. ...	.....	93	1-2	Fine \$25.
Florida.....	Laws 1879.	.....	.....	3141	Fine not more than \$100, or jail not more than 60 days.
Georgia <i>f</i>	1882.....	.....	10	1456-9	Fine not more than \$1,000, or 1 year in chain gang, or both.

a S 1847 : Burning off permitted when consent of neighbors is secured after 1 day's notice.

b Pol. Code S. 3344-5. Persons firing woods, etc., liable in treble damages. Constable, etc., may order any inhabitants liable to poll tax to assist in extinguishing fire.

c See page 5.

d Must give notice, before burning off, to all residents within one mile, and can only be done between February 15 and March 31, unless otherwise ordered by county commissioner.

e Prohibits building fire in woods without owner's permission, and without first clearing away combustibles, and extinguishing fire.

f Must give 1 day's notice, before burning off, to adjoining property owners, and then only between February 20 and April 1.

Summary of forest fire laws—continued.

State.	Edition of Code.	Table.	Chapter.	Section.	Penalty.
Idaho	R. S. 1887.	9		6921	Misdemeanor.
Illinois	R. S. 1895.		38	18	Fine \$5-\$100.
Indiana	R. S. 1894.		5	2001	Fine \$5-\$100 to which may be added imprisonment not more than 30 days.
Iowa	McLean's 1888.	24	3	5185-92	Fine not exceeding \$500, or jail not exceeding one year.
Kansas	C. L. 1889.			7276-8	Fine \$50-\$500, or jail 10 days to 6 months, or both.
Kentucky	G. S. 1888.		29	5-6	Fine \$100, or in discretion of jury.
Louisiana	1884.....			817	Fine \$5-\$500.
Maine <i>g</i>	Laws 1891.		100	5	Fine not exceeding \$100, or jail not exceeding 30 days, or both.
Maryland <i>h</i>					
Massachusetts <i>i</i>	Sup. 1888.		163	1-2	Fine not more than \$100, or jail not more than 6 months.
Michigan <i>j</i>	Howell's A. S. 1882.		328	9402-4	Fine not more than \$100, or jail not more than one year, or both.
Minnesota <i>k</i>	G. S. 1878.		95	6	State prison 6 months to 2 years.
Mississippi	1892.....		29	1091	Fine \$30-\$200, or jail not more than 3 months, or both.
Missouri	R. S. 1889.		47	3613	Fine not more than \$500, or jail not more than 12 months.
Montana <i>l</i>	P. C. 1895.			1071-2	Fine not more than \$1,000, or jail not more than 1 year.
Nebraska	1895.....		c. c. 9-62	6713	Fine \$5-\$100 and jail from 1-6 months.
Nevada.....	G. S. 1885.			4794	Fine \$200-\$1,000, or jail 10 days to 6 months, or both.

g See page 4.*h* No law included in Revised Statutes.*i* Ch. 296, S. 1-6, G. S. 1883: Duty of fire wardens to post warnings, extinguish fires, and investigate causes of fires.*j* Supervisors and highway commissioners to order assistance in putting out fires; fine \$5-\$50 for refusal to assist.*k* See act of April 18, 1895, quoted entire in this circular (Page 1).*l* Penalty for failing to extinguish camp fire; or malicious firing of woods fine not exceeding \$5,000, or imprisonment not exceeding 5 years, or both.

Summary of forest fire laws—continued.

State.	Edition of Code.	Title.	Chapter.	Section	Penalty.
New Hampshire ^m	P. S. 1891.	.....	277	3-7	Fine \$10-\$2,000, or imprisonment not more than 3 years.
New Jersey ⁿ	R. S. 1877.	Fire,		1 and supplements.	Fine not more than \$100, or jail not more than 1 year, or both.
New York ^a	R. S.	14	20	.....	Fine not exceeding \$1,000, or imprisonment not exceeding 1 year.
North Carolina ^b	Vol. 1. 1883 .....	.....	7	52-4	Fine \$50.
North Dakota	1895 .....	.....	P. C. 40	7314-15	Wilful, a misdemeanor; negligent, fine \$10-\$100.
Ohio ^c	R. S. 1894.	.....		6334	Fine not more than \$100, or jail not more than 20 days, or both.
Oregon ^d	Sess. 1893	.....		Page 45	Fine \$10-\$1,000, and in certain cases penitentiary not exceeding 1 year.
Pennsylvania ^e	1894 .....	.....		Act of June 11, 1879-81	Fine not more than \$300, or jail not more than 1 year, or both.
Rhode Island	G. S. 1886 .....	.....	279	6	Imprisonment not exceeding 2 years.
South Carolina ^f	1893	Crim. Stat.	101	151-7	Fine \$5-\$100, or jail not more than 30 days.
South Dakota	Dak. Ter. ....	.....		2398	Fine not more than \$500, or jail not more than 1 year, or both.
Tennessee ^g	M. & V. C. 1884.	.....		2277-8	Forfeit \$100 to prosecutor and fine \$5-\$50 (S. 2277 Code Sup. 1893)
Texas	P. C. 1889.	17	2	69-70	Fine \$50-\$300.
Utah ^h	C. L. 1888.	10		4576	Misdemeanor.
Vermont	1894	32	213	4934	Fine not more than \$500, or penitentiary not more than 5 years

^m See page 6.ⁿ Ch. 188, G. P. Laws 1888. Provides detectives for violators of fire law Ch. 119, Laws 1892, and Ch. 194, Laws 1894. Provides for fire marshals and defines their duties.^a See page 6.^b Fine \$10 for leaving unextinguished camp fire. Two days' notice in writing before firing one's own woods.^c S. 4750-1; Penalty for refusing to assist in extinguishing fires, fine \$10.^d Requires governor to issue proclamation annually July 1, warning people against forest fires.^e See also page 6.^f If turpentine farm, fine \$500, or penitentiary 1 year.^g Owner may fire his own woods after two days' notice to neighbors.^h Ch. 27, Laws 1892. Duty of county sheriffs to extinguish fires.

Summary of forest fire laws—concluded.

State.	Edition of Code.	Title.	Chapter.	Section.	Penalty.
Virginia	1887 .....	.....	181	3701-2	Fine \$5-\$100, and jail 1 to 6 months.
West Virginia	1891 .....	.....	2	81-84a	Fine \$10-\$1,000, or jail not more than 1 year.
Wisconsin ⁱ	R. S. 1869.	.....	.....	4406	Fine not more than \$500, or jail not more than 1 year.
Wyoming ^k	R. S. 1887.	.....	.....	920-2	Fine not more than \$500, or jail 30 days-6 months.
Arizona	R. S. 1887.	.....	.....	608-9	Misdemeanor. If on State or U. S. lands, fine not more than \$1,000, or jail not more than 1 year, or both.
New Mexico	1884 .....	.....	.....	2313-4	Fine \$60-\$500.
Oklahoma ^l	1893 .....	.....	{ 25 37 entire.	2269-70	Fine \$10-\$500, or jail not more than 1 year, or both.

ⁱ See page 4.^k Permits firing grass and sage-bush, March, April, and October, if kept within control.^l Camp fires ; and regulations for bringing off prairies, etc., Ch. 37 (enacted 1890) provides penalties for setting fires and failure to extinguish.

B. E. FERNOW,

Approved.

Chief Division of Forestry.

J. STERLING MORTON,

Secretary of Agriculture,

WASHINGTON, D. C., March 16, 1896.

THE INDIAN FORESTER.

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[No. 9

Remarks on the new Edition of D'Arcy's "Forest Working-plans in India."

It is to be regretted that the late Mr. D'Arcy is no longer amongst us to revise his interesting work on the organization of forests. The editor of another's work must always be handicapped by the feeling that he is not justified in altering materially the views expressed in the original text, no matter what his own opinion may be; but the author himself need have no scruples of this kind and can, if necessary, alter his views to suit the dictates of more mature experience.

The second edition of this book has been brought out by an unknown hand, without, it is stated, much alteration of the original text. But it is, unfortunately, issued from the office of the Inspector-General of Forests to the Government of India, and, although it is distinctly stated in the preface that the book is not to be regarded in the light of an official code of instructions, it bears the imprimatur of the head of the Forest Department, and will, no doubt, for this reason, be very generally followed by Forest officers, whether they agree with all the views it contains, or not. Such a consummation is scarcely to be desired, as we must look to the researches of practical organizers to clear up much that is obscure in the organization of forests, and this object is not likely to be promoted by blindly following any particular author.

Perhaps the worst feature of a short treatise on a complicated subject is that the writer, being necessarily cramped in regard to space, cannot always find room for the opinions of every writer of eminence, with the result that he may be constrained to lay before his readers incomplete accounts of matters of importance, or even to state only his own opinion, on controverted subjects, without affording the uninformed reader an opportunity of forming by comparison an opinion of the soundness of his conclusions. The present work is necessarily by no means free from this defect.

An important subject—the determination of the most advantageous revolution—is, for example, most inadequately discussed, and the reader is left entirely in the dark regarding the fact that the views held by the author are diametrically opposed to those of many—it might even be said, most—leading authorities of our day. Again, when dealing with the subject of interest, the author briefly dismisses it with the remark that, although of considerable theoretical interest, a discussion of it is of no practical value; presumably, because its practical application has not come within the purview of his own particular practice. These examples, which might easily be multiplied, suffice to illustrate the disadvantages under which an author labours when attempting to write a short treatise on a wide and much discussed subject.

It is a question if the title of the book should not have been "on the organization of forests" instead of "on the preparation of working-plans." The author really endeavours to give a more or less complete review of the whole range of organization, and goes far beyond the actual working-plan of the forest. Indeed, it is difficult to conceive how a pamphlet on working-plans, pure and simple, could be made intelligible without a review of the whole subject of which the working-plan is a part; and the author, by the way in which he has dealt with his subject, tacitly acquiesces in this view.

He begins by defining a number of terms, some old and established, some new: and some which, though old, can scarcely be said to be established, and which appear to require reconsideration; and again, some of which the definitions do not appear to me to be quite correct. 'Windfall,' for example, I have always understood to refer to trees, or portions of trees, thrown down, or broken off, by natural causes only. The term "leaf-canopy" is to my mind rather far-fetched, and I think that the term "leaf-cover," or simply *cover* is a more simple, and, therefore more acceptable term. The word *pure* appears to be out of place in connection with crops, and I prefer the term *unmixed*. The term *pure forest* does not convey to the uninformed the idea of a forest which consists of only one species, but of a forest in which there is nothing except trees, whereas the term *unmixed* does. *Pure* is the opposite of *impure*; therefore, the latter term should be applicable to mixed forest, but would anybody dream of applying it in that sense. The word *pure* in this connection is just a bad, though literal, translation of the German word.

The term "tree" is defined as a woody plant having a single stem of considerable length and which is capable of attaining a height of at least 25 feet; while a "shrub" is said to be "a plant which does not attain a height of 25 feet and which generally throws out branches at or near the ground." According to these definitions, a tree whose stem has been cut off near the ground and which throws out shoots from the stump, is no longer a tree, nor is it a shrub. And, according to the latter definition, any herbaceous

plant which branches near the ground is a shrub. I think these definitions require revision.

Density is defined as the degree of completeness of the "leaf-canopy" (or, as I would prefer to call it, 'cover'). I believe, however, that this term usually refers to the quantity of growing stock, not to the completeness of the cover. If I say that a group is .5 stocked, I mean that the ground is only half-stocked with trees; that it could carry twice as many if fully stocked. In this sense, the cover may be complete in an incompletely stocked wood. This confusion of ideas leads the author to a confused conception of the terms *complete* and *incomplete* density. He says that a crop is complete "when it presents a density conformable to its nature and age; when this is not the case, it is incomplete." There is nothing contradictory in this rather abstract definition if the word *density* means, what I conceive it to mean, but it will not do if the author's definition of density be accepted. He says, "the density of a crop is the degree of completeness of the leaf-canopy"; from which it follows absolutely that when the leaf cover is complete, the density is complete, and, when the cover is incomplete, the density is incomplete, without any possible modification due to the "nature and age" of the crop.

The term *cover* (of a tree) is defined as the horizontal projection of the crown on the ground. So far, so good. But I would add that the cover of a *crop* is complete when the shade afforded by its cover is perfect, less degrees of cover being usually expressed in decimals, from .9 to .1.

High forest is a term which might be abolished in a technical sense from our forest literature. *Seedling forest* is in every way a better term. It is ridiculous to call a group of seedlings a year old, high forest. There is apparently no necessity to use a term in a technical sense simply because Germans have been so illogical as to introduce and perpetuate it in their language.

The author defines a *seedling crop* as a seedling forest up to the time at which its "newly developed branches meet." This appears to be a rather vague definition, and to clash with the definition of *seedling forest*, which is stated to be, unconditionally, "a crop composed of trees which have sprung from seed." I take it that a crop is a seedling crop provided it originates directly from seed (*i. e.*, is not coppice, sucker, nor pollard growth), no matter whether the "newly developed" branches have met, or not. Its essential characteristic is that it originated directly from seed, and this fact is not affected in any way by the meeting of branches new or old.

To an Englishman, the term "storeyed forest" (? storied forest) must always appear ill-chosen. It conveys the idea of one well defined thing on the top of another, and so on, in regular order. But no forest grows in layers in that way, and the so-called storeys must be imperceptible to the eye. It is apparently a form

of *jardinage*, invented recently ; it might be given the name of its inventor.

In referring to the method of natural regeneration by seed, the author speaks of a preparatory, or seedling-felling. I think he should have said a preparatory *and* a seedling-felling (German—*Vorbereitungsschlag* and *Besamungsschlag*) ; the first being made with a view to the preparation of the ground for the reception of seed and the second with a view to favour the seeding of the tree.

The definition of a *block* given by the author does not coincide with that of German writers, but with their definition of compartment and his definition of compartment with their sub-compartment.

The term *cutting rotation* is used in this book to denote the period required to work through a series from end to end in *jardinage*. I think the term *cutting cycle* would be a more expressive and appropriate term, because it appears to me to be undesirable to use the word *rotation* in any sense except that in which it is used in agriculture.

A term is wanted to denote a mass of forest of uniform appearance—a word equivalent to the German word *Bestand*. I have used the word *group* in this sense ; it is certainly not a very appropriate term, but I cannot find a better.

On the vexed question of the scale on which maps should be drawn, the author has not much to say. He considers that the 4-inch is generally the largest required in India, and this opinion will probably tally with the experience of most Indian foresters.

It may, however, be doubted if it is always desirable to show all the natural features, such as hills, valleys, water-courses, etc., on the maps. There is, I think, a tendency to the over-elaboration of forest surveys in this country—a fact which, if true, is not unnatural, considering that they are generally the work of a separate department whose members are ignorant of forest requirements, and who are naturally anxious to make them as perfect as possible. The assumption of a certain standard of average cost per square mile as a fair cost for a survey on a given scale also tends towards a high rate relatively to the value of the country surveyed : the Survey Department is apt to think that if it can keep its average cost per square mile down to, say Rs. 180 for a given scale, it is doing very well. Vast areas are often surveyed on the same plan, all with the same degree of minuteness of detail, when a very varying quantity of detail would often be indicated, and in this way large tracts may easily be taken up, for which maps are either not required at all, or for which mere skeleton maps would answer every purpose. There must be few foresters of long experience who could not cite cases in which a delineation of boundaries

would have answered all practical purposes, but in which more or less elaborate surveys have been carried out.

Had the author lived to revise his work, it is a question whether he would not have seen fit to modify his views regarding the formation of so-called working-circles. It may be doubted if limits to the size of working-circles are a matter of importance, although the size of coupes may be and often is, a matter of great moment. On page 37, he writes, "If the circles are too large, the area to be exploited in one place, or at each operation, may be inconveniently extensive, and the distance to which the material must be conveyed too great; or more produce may have to be felled than can be consumed in the centre of consumption, to which it must be transported if it is to be utilized at all." "Generally speaking, when all the produce of the fellings is saleable the working-circles would be comparatively small." Again, "It should be remembered that when equality of yield from year to year is desired, such equality can be better secured by forming a number of small, rather than a few large, circles." From these quotations it certainly appears that the writer assumes that only one cutting should be prescribed annually for each circle. There is also good reason to suppose that he is an advocate of the location of the annual cuttings in regular succession one behind the other.

This idea, that coupes should be made one behind the other in regular succession, or that only one coupe should be carried out every year in each working circle is surely out of date. There appears to be little or no advantage to be gained by such a procedure in forests subject to regular methods of treatment, while its rigidity may be the greatest hindrance to elastic and economical management, and it could probably never be carried out in hitherto unorganized forests subject to regular methods of treatment, except at great loss to the proprietor.

It is difficult to understand how the author came to consider that only one coupe should be made each year for each working-circle; but that such was the case appears to be quite certain. The paragraph quoted would otherwise have no meaning, because in large circles the coupes could be increased to any required number, and suitably located.

That he would also prescribe that, as a general rule, with possibly a few exceptions, the exploitation each year of one coupe behind the other in regular succession, is certainly not evident from the above quotations, but there can, I think, be no doubt about it, because on page 22 he refers, with approval and without adequate qualification, to clearances made in regular succession, and returns to the subject on pages 34 and 67. On page 22 he writes, "or the clearances may be made in regular succession over small adja-

cent areas," and on page 84 we find that "where the whole crop is saleable, and in climates where natural reproduction is assured, the method of *clearing* or *clean felling*, *adjacent* areas may be applied in certain cases for the sake of its extreme simplicity and the order it introduces into the fellings. It should not, however, be made use of where the working circle and consequently the coupes are very large, as it leaves reproduction to chance, and the larger the coupes the smaller the chance." On page 67, a general rule for all *régimes*, is laid down; "the fellings should be adjacent and succeed one another in the order in which made;" there is nothing in these extracts to shew what heavy sacrifices the proprietor will have to make in—I think, I may say *all*—cases except those in which the *régime* of *jardinage* is prescribed, a possible defect of the method which should, one would think, be noted in a work on organization.

Under "analysis and description of the crop" the *block* is taken as the permanent unit of description. It answers, as already observed, to the compartment of the German forester, whose blocks consist of 2 or more compartments. I must say I prefer the term compartment for the unit, and its use gives us the advantage of having the additional term *block* to denote a compact series of compartments separated from others, or from the other areas by main rides or their substitutes.

In this section, the density is again referred to as being measured by the density of the leaf-cover, instead of by the relative density of the trees as compared with a complete crop.

The author is somewhat doubtful regarding the usefulness of written descriptions of blocks (compartments). He considers that they are not of much use to the organizer himself, nor to those whose business it is to scrutinize the plan, and that possibly stock-maps would be preferable. This supposition may possibly be true for *jardinaged* forests, but would scarcely apply to groups subject to other *régimes*. The usefulness of written descriptions will probably be better appreciated in subsequent years when comparing the then state of the compartments with their former state, and no stock maps could make up for the written description. No doubt they are often too prolix, and the description for one compartment would often do for several others.

The plan adopted by Colonel Wilmer, and quoted by the author, of classifying areas according to species and soil at the time of the survey of the forest, would probably cost more than it was worth, as no forester could organize his forests from such descriptions or without going over the ground himself, but they might sometimes be useful for large tracts of waste land by assisting a selector to determine which areas to keep for forest and which to leave for the extension of cultivation.

At page 44, the term "valuation survey" is used to express the procedure known to Frenchmen as "the taking of the inventory

of the forest." The former term is of old standing in India, but it is obviously a wrong term, as there is no valuation about it. I have used the term *assessment* to express the same meaning, but it, too, is open to objection, and I think a more appropriate term to be "The taking of the inventory," or "stock-taking," as that is what the operation really consists in—not in making an estimate of its value which must come after the taking of the inventory.

It may be doubted if there be anything gained by separating sound from unsound wood in the inventory. It is quite impossible to say which growing trees are sound or unsound, and nearly every mature tree in the large timber forests with which I am acquainted, turns out unsound when felled, although it may be growing vigorously. Dead trees, on the other hand, can be recognized and should certainly be left out of the enumeration altogether, as they will generally come away with the thinnings.

In dealing with the calculation of the volume of trees, the author refers to "type trees" and "form-factors;" the terms "test-tree" and "form co-efficients" appear to me to be preferable, more particularly the latter, which is, at all events, English for what is meant, whereas the words *form-factor* and *reducing-factor* (which are often used) are just bad translations of the German term.

I now come to that part of the treatise which deals with the exploitable age of trees (p. 58). A general rule is laid down that *price* is the best guide to the determination of the most advantageous revolution.* In other words, that revolution which is calculated to afford the highest net annual revenue is recommended as most advantageous; local conditions may sometimes necessitate its modification or abandonment, but otherwise the guiding principle for the determination of the most advantageous revolution is, according to our author, *price*.

If carried out to its logical conclusion, this principle would necessitate the prolongation of the revolutions of most of our timber-species far beyond the age at which they are usually considered exploitable. Seedling teak would ordinarily have to be subjected to a revolution of 250 years or more, and other large timber species in proportion to their longevity. Six-inch timber will nearly always be more valuable than three-inch; that is to say, it will fetch a higher net price per cubic foot, and 9-inch than 6-inch, and so on up to a certain point. As regards this point, it appears to be merely a question of fairly good communication and the strength of the means of transport; as long as these are sufficient, the larger timber will, so far as my experience goes, always fetch a higher net price.

On page 59 it is stated that "Indian forestry is not ripe for elaborate calculations and must be satisfied with felling when the revenue will be highest or the produce most useful, otherwise

* I use this term in preference to *rotation* because the latter has quite a different meaning in agriculture and refers to successive changes of crops. *Revolution*, on the other hand, has no double technical meaning, and should, for this reason, be preferred, I think.

it would be also necessary to consider the greater capital involved in producing the larger-sized timber in view to taking account of the rate of interest (*sic*) on that capital." What does the writer mean by "the most useful produce," and how are we to decide which description is really the "most useful." The term "most useful produce" is one that French writers are very fond of, and I think I am right (I quote from memory) in saying that M.M. Nanquette, Broillard and Paton agree in considering that the most useful wood is that for which the highest price is obtainable per unit of measurement. Possibly I should say the highest net price. That point is, however, of no consequence, so far as I am concerned, as either assumption is wrong according to my view. The late Mr. D'Arcy seems to have followed the French School in this, as well as in many other matters; and I think we might, therefore, take for granted that his "most useful produce" is that for which the highest net price is procurable, and that, consequently, the revolution under which the most useful produce is obtainable is, according to his view, that for which the highest net price is obtainable. But, on page 58, he makes this point quite clear by stating that "when poles, or timber in the rough or logs, are sold, the price realized per cubic foot for differently sized pieces directly indicates the size of the trees which are most useful."

To prove the erroneousness of this view ought not to be a very difficult task. The principal point is that the values of two things received at different times cannot be directly compared. If I am offered the choice of a penny-loaf now, or a year hence, one offer is distinctly more advantageous to me than the other, although the intrinsic value of each loaf is the same. Or, if I am to-day offered a group of trees worth £1,000, or am promised, as an alternative, twenty years hence, a block which will then be worth £2,000, should I not, before deciding, ascertain what the net value of the latter is discounted to the present day, and having settled this point, accept the offer calculated to give me the highest return? Whether the late Mr. D'Arcy would, in my place, have acted in this way, is perhaps doubtful, but it is quite certain that, if he acted on the principle laid down by him in this book, he ought not to have done so. Suppose, now, that a perfectly safe investment, at 4 per cent. interest, can be obtained on mortgage of landed property or in other ways; before deciding which offer to accept, I naturally determine to find out what a sum of £1,000 comes to at 4 per cent. interest, in 20 years. That sum amounts to £2,191, and I of course accept the group worth £1,000 at the present moment, put the sale-money out to interest, and after the lapse of 20 years am £191 richer than would have been the case had I accepted the other offer. It is quite immaterial to me what the value of a cubic foot of each group is worth at the time of exploitation. Similarly, if I wish to find out whether a group is financially mature now, or if

it would be more advantageous to leave it standing twenty years longer, I must at least compare its value now with its prospective value twenty years hence, and cut it at once, or allow it to stand, according as its prospective value, discounted to the present time, is less or more than its present value. I can, if I wish to be more accurate, introduce certain refinements into the calculation, but in no case can the net value of a cubic foot of the produce be of the slightest assistance, except to enable me to estimate the value of each group at the time of cutting.

Strictly speaking, the most advantageous revolution is of course that which affords the highest prospective land-value; and if, for a unit of area, H_r represents the net value in the year r of the main cutting: r =the length of the revolution: D_a, D_b, \dots, D_n =the net values of minor receipts harvested in the years a, b, \dots, n : p =the rate per cent. at which the proprietor can borrow money: c =the cost of cultivation: V =a capital, the interest on which will defray all annually recurring expenditure on account of supervision, taxes, etc.: B =the value of the land:

Then, for any revolution, r ,

$$B = \frac{H + D(1 \cdot 0p)^{r-a} + D(1 \cdot 0p)^{r-b} + \dots + D_n(1 \cdot 0p)^{r-n} + c(1 \cdot 0p)^r}{(1 \cdot 0p)^r - 1} - V$$

It may at once be admitted that it is seldom possible to obtain all the *data* necessary for the exact calculation of the land-value, for different revolutions, in the above manner. The number and exact value of successive thinnings will seldom be known and even the estimate of main cuttings may be difficult to make with accuracy. The value of V is the same for all revolutions and may, therefore, be omitted. The cost of cultivation, if any, should *generally be ascertainable, but neither it, nor the value of intermediate cuttings, can greatly affect the length of the financial revolution.* When, therefore, the intermediate receipts are not known, they may, I think, for all practical purposes, be neglected. The estimate would then be generally confined to the main cuttings.

It seems to me that too much importance has been attached by the opponents of the financial mode of treatment to the difficulty of ascertaining accurately all the *data* necessary for a strictly scientific solution of the problem. What appears to me to be wanted, both in this country and Europe, but more particularly in this country, is, not a pedantic estimate, but one which is calculated to give fairly accurate results, or, at all events, to prevent gross errors, which cannot fail to be of frequent occurrence if we rely on the revolution which is calculated to afford the highest net revenue. Nobody pretends that even under the most favourable circumstances, the financial revolution can be determined with mathematical accuracy, but it seems to me to be going too far to assert, as the advocates of the chance procedure

recommended in this book virtually do, that because some *data* necessary for exact determination are seldom or never available, all attempts at approximation should be abandoned. It would be almost as reasonable to assert that because the area of a circle cannot be exactly determined, it is useless for practical purposes to attempt to calculate the contents of a cylinder. It also seems to be unreasonable to expect to obtain better results from a method based on irrational principles, than from one which, although imperfect, starts from a rational basis, and is as far as possible correct.

I am inclined to think the problem can often—perhaps in most cases—be still further simplified by taking a single average tree as the standard of comparison instead of the crop on a unit of area. I see no reason why this mode of dealing with the matter should not answer perfectly for all practical purposes in connection with forests with which I am acquainted. It may even be possible sometimes to employ a method which does not necessitate the determination of the full age of the trees examined although this factor can generally be determined with sufficient accuracy. Take, for example, jardinaged forest: the important point to decide is the diameter, at breast height, of a tree, which roughly corresponds with its financial maturity. In the case of teak and other species with long revolutions, an approximation within 20 or 30 years of the true revolution, should satisfy all practical purposes. We might, then, according to this plan, proceed as follows:—Compare the value of typical trees of different diameters, proceeding by differences of, say, 4 inches, or such other magnitude as may be considered desirable in each case. Say we wish to compare the value of the 20-inch tree with that of the 24-inch tree in a teak-forest, and that it takes 30 years, as ascertained by experiment, for the 20-inch tree to grow into a 24 inch tree. We first of all determine the value of a 20-inch tree by felling and cutting up a few averaged sized trees of that class. In order to determine the value of their produce, it may be put up for sale in the usual manner, or its value may be estimated from the previous knowledge of the value of a cubic foot of each description of saleable produce yielded, which would probably be generally a better plan. From the total sum thus obtained, the cost of cutting and transport to a sale-depôt would have to be deducted; and the remainder, divided by the number of trees examined, would give the net value of a tree of 20 inches diameter.

In the same manner, the contents and net value of a 24-inch tree can be determined. Or, its volume can be determined by adding to the saleable volume of the 20-inch tree its increment for 30 years. The net value can then be easily calculated, including a quality-increment if any is expected.

The question that remains to be decided is whether it will be more profitable to cut down the trees when they are 20-inches, or when they are 24 inches, in diameter. Supposing, now, that the

20-inch tree yields saleable produce of the value of Rs. 40 net, that the 24-inch tree yields saleable produce of the value of Rs. 150 net, and that the rate of interest is 4 per cent. The present value of the 24-inch produce which would be realised 30 years hence would be $150 \div (1.04)^{30} = \text{Rs. } 46$. It would, therefore, be more profitable to allow the trees to stand until they attained a diameter of 24 inches. It would then be desirable to determine the value of a 28-inch tree as compared with one of 24, and so on until a maximum is reached.

Not long ago, a case occurred in which it was a question whether the revolution of certain teak forests, should be of 30 or 60 years. The organizer was in favor of one of 30 years, while some others inclined towards one of 60. It was found that the net value of a stem 30 years old was Re. 1, while that of a stem 60 years old was Rs. 2. Two revolutions of 30 years would pass away during one revolution of 60, and it was argued, against the organizer's view, that the net returns would be exactly the same for either revolution, namely Rs. 2, and that the pecuniary profit to Government would, therefore also be the same in each case. How fallacious this opinion was is evident if the respective receipts be put in a more proper relation to each other.

Applying the rough mode of calculation just described, we should arrive in the following manner at a more correct comparison of the figures. The estimate is made for 60 years, as two revolutions of 30 years are comprised within that period and one of 60.

30 years' revolution.

	Rs.	Rs.
At the end of the first revolution each stem is cut and realizes Re 1. This sum carried forward for 30 years, at 4 per cent. interest, amounts to	3½
Add for each stem available at the end of the 2nd revolution	1
Total ...		4½

60 years' revolution.

The net value of a stem 60 years old is	2
Difference ...	2½

The 30 years' revolution is, therefore, according to this estimate more than twice as profitable as one of 60 for these particular forests, apart from sylvicultural and other economical reasons that all point towards the desirability of a short revolution.

The following would be a more correct mode of comparing the two revolutions, and could be easily carried out:—

For the 30 years' revolution.

The present value of a stem	
obtainable every 30	
years would be ...	Rs. $1 \div (1.04)^{30} - 1 = .45$
The present value of a stem	
obtainable every 60	
years would be ...	Rs. $2 \div (1.04)^{60} - 1 = .21$

<i>Difference</i>	<u>.24</u>
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This result comes to much the same thing as that first obtained. It shows that the 30 years' revolution would be more than twice as advantageous as a revolution of 60 years.

The correct formula for the prospective value of the soil and consequently, the relative values of revolutions, is as given above,

$$B = \frac{Hr + D_a(1.0p)^{r-a} + D_b(1.0p)^{r-b} + \dots D_n(1.0p)^{r-n} - c(1.0p)^r}{(1.0p)^r - 1} - V$$

For the case just cited, I am not at present in a position to cite the exact *data*, although I have no doubt that they are ascertainable with as much accuracy as is generally possible in such cases either here or in Europe. I will, however, attempt to give them approximately, because it is desirable to illustrate the bearing that some of the items in the calculation have on the length of the financial revolution.

Let us suppose, then, that the fully-stocked acre will hold, on an average, 1,000 stems of 30 years of age, or 300 stems of 60 years of age: that, between the ages of 30 and 60, a group yields 700 stems, in thinnings, realized, on an average, in the 45th year of its age, and of the average value of $1\frac{1}{2}$ rupees each. Further, that the yearly recurring expenditure on account of supervision, taxes, etc., is 4 annas per acre; the cost of cultivation Rs. 10; the rate per cent. on borrowed capital 4, and that no receipts can be obtained from thinnings up to the 30th year. We would then have:—

(1) *For the revolution of 30 years.*

$$B_{30} = \frac{1000 - 10(1.04)^{30}}{(1.04)^{30} - 1} - \frac{.25 \times 100}{4} = \text{Rs. } 424$$

(2) *For the 60 years' revolution.*

$$B_{60} = \frac{300 \times 2 + 700 \times 1.5(1.04)^{60-45} - 10(1.04)^{60}}{(1.04)^{60} - 1} - \frac{.25}{0.04} = \text{Rs. } 244$$

The difference in favour of the shorter revolution is, therefore, Rs. 180, and an investor who is satisfied with 4 per cent. interest on his capital could afford to pay Rs. 424 for land, for which, under a revolution of 60 years, he could afford to give only Rs. 244.

Now, supposing that in this case, no thinnings were made between the 30th and 60th years, and that the 1000 stems of the value of Rs. 2 each survived to the 60th year. The result would be that prospective value of the land would be reduced to Rs. 193 and that the 60 years' revolution would not be half as profitable as one of 30. Although intermediate receipts do not seriously affect the length of the financial revolution, they may add, if judiciously made, very considerably to the value of the returns. In order to more fully illustrate this point, which has an important bearing on the view I hold regarding the determination of the revolution, and in justification of my remark that intermediate receipts and the cost of cultivation have no marked influence on the length of the financial revolution, I take the following table of the yields of Scot's pine for successive revolutions, and calculate the returns with, and without, thinnings :

Yield of one Morgen stocked with Scots' pine
(Taken from Burekhardt's Hülfsstafeln für Forsttaxatoren).

Age of group.	Corresponding value of thinnings.	Value of remaining standing stock after thinnings.	Value of main cutting.	Cost of cultivation.	Yearly recurring expenditure.
Years.	Thalers.	Thalers.	Thalers.	Thalers.	Thalers.
20	1.0	8.0	9		
30	3.5	21.7	25.2		
40	4.8	50.7	55.5		
50	5.6	100.0	105.6		
60	6.6	165.3	171.9	2.0	0.3
70	7.5	240.0	247.5		
80	7.4	293.3	300.7		
90	7.2	344.0	351.2		
100	—	—	375.0		

Taking the rate on borrowed money to be 3 per cent., the prospective value of the land, for these yields, culminates in the 70th year, with 30 thalers, including the value of all thinnings.

If, now, we exclude the value of the thinnings from the calculation, the prospective value of the land still reaches its maximum in the 70th year, but falls from 30 thalers to 18½. For a revolution of 70 years, the value of the thinnings in the 70th year amounts to 15 per cent of the main cutting, and yet the financial revolution is neither advanced nor retarded by their omission in the least degree.

Nor can the cost of cultivation appreciably affect the length of the revolution. In the above example, the cost of cultivation is Th. 2, and the capital represented by that sum is $\frac{2(1.03)^{70}}{1.03^{70}-1}$ for

a revolution of 70 years, or just about $2\frac{1}{3}$ thalers. For a revolution of 50 years, it would be about $2\frac{2}{3}$ for one of 100 years slightly over 2 thalers. The difference between the capital of cultivation for a revolution of 50 years and of that for one of 100 years is quite insignificant when compared with the magnitude of the net receipts, and could have no effect whatever on the length of the revolution.

The annually recurring expenditure is, as already noted, the same for all revolutions, and has no influence on the length of the revolution.

When, therefore, the items, on which the financial revolution is based, are examined closely, we find that the only really important one is the value of the main cutting, and we are forced to the conclusion that all others may safely be left out of the reckoning. Even Mr. D'Arcy's mode of procedure presupposes a knowledge of the value of main cuttings, or of average trees for different revolutions, so that really the demand his method makes on our knowledge is just as great as that made by the more correct method, and it may safely be left to the unprejudiced reader to say which of the two is more likely to be satisfactory in the long run.

I have dwelt at considerable length on this part of the subject because I think I notice a tendency, not only in the late Mr. D'Arcy's book, but also in other quarters, to deprecate all attempts at what may be appropriately called rational, in contradistinction to what may be equally-appropriately styled haphazard-organization. I also think there is a widespread inclination to appeal to the State to grow blindly the largest timber possible, whether national interests are really best served in that way, or not. That the general adoption, in respect to State forests, of the late Mr. D'Arcy's recommendations must lead to excessively long revolutions and heavy losses to Government, has, I think, been proved, and also that financial revolutions can generally be ascertained with sufficient accuracy for all practical purposes. If this much be admitted, revolutions based on the highest net value of a cubic foot of wood should soon be as obsolete in India as they are in those countries in which a more complete knowledge of the true objects of state forestry has driven out pure sentiment and replaced it by a more practical spirit.

Chapter III deals with the preparation of the working-plan. Reference is made to a preparatory period, or period within which the abnormally-constituted forest shall be brought into the ideal state, and it appears that the author considers that this object should be attained at any cost, within the period of a revolution, if not sooner. The tendency of most eminent writers of the day is, I think, not to seek to bring about the ideal state suddenly, when it can be thus effected only at great sacrifices by the proprietor,

but to attempt to realize this object, in very abnormal series, by slow degrees. The older German writers, and most French writers with whose works I am acquainted, attach great importance to the rapid establishment of an ideal state. With the advent of Pressler and his school some 30-40 years ago, the impolicy of this view was brought very forcibly to the minds of younger generations, and many writers now think that the economical working of forests is a matter deserving of quite as much attention as the early attainment of the ideal state. The organizer, they consider, should, without losing sight of the ultimate establishment of a regular system of age classes, on no account neglect financial considerations. In my opinion, this is a very sensible view to take of the matter, but it is natural enough that men, who, like the late Mr. D'Arcy, think so lightly of money losses, should stick to old ideas, and desire to see the supposed ideal state established, with the least possible delay, at any cost.

Another point, on which many readers of the '*Forester*' will join issue with the author, is the alleged desirability "where a sustained yield is not of special importance" of forming permanent annual coupes. This opinion is stated in reference to jardinaged forests, but whether it is intended to refer to all forests, as I imagine, or only to jardinaged forests, it is impossible to say for certain. What leads me to suppose that the rule is intended to be of general application is that if it is true for one kind of seedling-forests *régime*, it is also true for all others, and, *à fortiori*, for coppice.

On page 66, the institution of coupes inversely proportional to the wood they contain is objected to on the ground that during the next felling cycle totally different annual coupes may have to be formed. If the coupes have been permanently marked off, this objection may be of some value, but if they have not been permanently marked off, it is difficult to see the force of the objection. But the advisability of marking off coupes permanently appears to be very doubtful, as a general rule. It certainly seems to me to be inexpedient, as a general rule, to mark off coupes permanently in seedling forests. It seems to be, in the first place, an unnecessary expense; in the second place, it makes no allowance for unforeseen changes in the crops, due to deterioration, improvement, or one or more of a hundred other unforeseeable circumstances that may occur during a revolution of 100-200 years and necessitate changes of system or treatment; in the third place, even should no accidents occur to mar the plan, it presupposes that the yield of each coupe will for ever be constant after the first revolution; in the fourth place, if seedling forests be divided up into compartments, (and where necessary sub-compartments) with well-defined compartment-boundaries, such boundaries will suffice for all requirements of orderly management, and there will be no necessity for the permanent demarcation of annual coupes. It seems to me, too, that even

under the coppice *régime*, which is generally a long one in this country, the marking off in a permanent manner of the annual coupes is frequently inadvisable. I have in my mind certain irregularly-stocked forests (which are, so far as my experience goes, the rule in India) which are so irregularly stocked that they could not be permanently marked off by means of equal annual areas, or areas inversely proportional to their productive power for the time being, without causing violent fluctuations of yield either in the first or succeeding revolutions.

In the older systems of organization, to which this book appears to adhere, there seems to be far too much rigidity and striving after finality to suit modern requirements and the advances made in our knowledge of the subject. Nobody will deny that the more elastic a system is, provided it is compatible with orderly management, the better it is for economical management.

I have already referred to the general rule, on page 67, that "the fellings should be adjacent and succeed one another in the order in which made," but will add a few more words on this important subject, against which a great deal, and for which very little, can, I think, be said. Disadvantages such as the following must at once occur to everybody :—that the coupes cannot be located alternately in different parts of the forest to suit market-demands: that great sacrifices may have to be made in irregular forests by the premature cutting of young groups and the retarded cutting of old groups: that the danger of the spreading of fires is much greater where the standing-stock is of about the same age on adjacent areas, *e. g.*, a succession of thickets in coniferous forest or grassy plantations in any forests: that when groups are languishing from injury by insects, or other causes, they cannot be removed until their turn comes: that injurious insects are more likely to spread: that a series of cuttings cannot be stopped in a block for a year or two, which may often be desirable owing to an attack of insects injurious to young growth, to temporary superabundance of wood in dépôt in the locality, or temporary absence of the usual demand. I do not know a forest in this country to which this rule could be applied with the exception of forests worked in *jardinage*, which is a system that admits of the forest being worked through from end to end with great rapidity.

Under the head "Method of simple coppice" (p. 68) the author recommends that the revolution should be as long as possible provided that the age at which the stools cease to produce shoots shall not be exceeded (? reached). He reiterates the rule that the fellings should, as a rule, succeed one another in consecutive order, and prescribes that the fellings shall be regulated entirely by area.

The first rule is, as I have attempted to shew, not a good one. The only reliable guide is in my opinion the financial revolution. The second rule has just been discussed, and

found wanting as a general rule, but may sometimes be followed without disadvantage. The third rule does not commend itself to my mind as a general rule. In irregularly-stocked but valuable timber-forests, and especially when they are badly stocked, it may often be advisable to adopt a system of felling partly by area and partly by mass. The enumeration of a thinly stocked area, in which all or nearly all species are saleable, is inexpensively and rapidly accomplished, and it will, I think, often be found convenient and economical to enumerate all trees on it, and to regulate the cuttings partly by mass and partly by area. If, for example, we have a teak-coppice subject to a revolution of 40 years, we might divide the area into 4 periodic areas each equal to about $\frac{1}{4}$ of the total area of the forest. For each period we could then cut annually one-tenth of the estimated number of stems on the corresponding periodic area. In this way the annual yield would be equal for a whole period, and, if judiciously chosen, the periodic areas could be made to yield about the same number of stems annually. At the same time, the periodic areas being fixed, there could be no fear of exceeding or undercutting the area-capability, even if compartments were not there to check errors of estimation. Or the periodic areas may be abandoned, more particularly if there has been a complete enumeration, as the compartments will constitute a sufficient check in that case. Personally, I am in favor of periodic areas, because I think it is neither necessary, nor desirable, to prescribe every detail for more than a decade or two in advance. Unforeseen circumstances may easily arise which render desirable a different distribution of cuttings of the remoter periods to that originally selected or even indicate the necessity of a totally different mode of treatment.

On page 78, we are introduced to what the author calls 'storied forest' (should not the term be written 'storied forest'?), which seems to be a species of jardinaged forest. The method appears to necessitate for its proper execution repeated enumeration of the standing-stock, and to be too elaborate to be of much practical value to the Indian forester. At the same time, it should be noted that "it has been largely applied in certain parts of France."

It is stated, on page 80, that, in jardinaged forest, the felling of each species should not be separately prescribed, but that at most the relative proportion of each kind should be prescribed. Again, on page 82, it is stated that "the enumeration would show the relative proportion of each species; and, in the working-plan, the fellings of each may be prescribed according to that proportion. Thus, suppose that 1-3rd of the trees enumerated were of species A, and 2-3rds of species B, and that the possibility were fixed at, say, 600 trees a year

we might prescribe the felling of 200 trees of species *A* and 400 of species *B*." It is not at all apparent why the rule should be followed. The species must be separately enumerated, and, after enumeration, if their growths or revolutions are different, their yields must be separately estimated. In fact, it appears to me doubtful whether it will not in all cases be advisable to estimate their yields separately. In any case the prohibition to give the yields of each species separately is not as easily understood as the author seems to assume.

The method of fellings limited by the productive capacity of the soil (page 88): that if fellings by relative proportion (page 90): and that of proportionate volume (page 93) will be only of academic interest to most Indian foresters.

J. L. L. MCGREGOR.

Stocks Maps and Enumeration Surveys.

**NOTE ON THE PREPARATION OF STOCK MAPS AND THE CONDUCT OF
ENUMERATION SURVEYS, BY F. B. BRYANT, ESQ., DEPUTY
CONSERVATOR OF FORESTS, CENTRAL CIRCLE.**

1. It is proposed to record a few notes on the preparation of stock maps, and the system of carrying out enumeration surveys, as adopted in the preparation of the working-plans for the Kumaun, Garhwal, and Ganges Forest Divisions of the Central Circle, North-Western Provinces and Oudh.

2. The Kumaun Division was that first taken in hand, and for a long time definite conclusions were not arrived at as to the most satisfactory method of treatment to be applied to the main sal forests, which are situated on the lower slopes of the Himalayas at an altitude of some 1,500 to 4,000 feet. At first it was considered that these forests could best be treated by "Improvement Fellings" carried out with a 10 years' rotation by area only; the quantity of material being unlimited save by silvicultural rules. With this end in view stock maps were prepared for all sal-bearing areas which had not already been examined and described during the preparation of Mr. Hearle's working-plan for the Nindhaur valley. In these maps an attempt was made to show the distribution of sal, sain, bamboos and trees of miscellaneous species by blue, red, green and black lines respectively. The density of the forest was shown by the proximity or distance of the lines apart, whilst the different age classes were represented by lines of different lengths. In the forests which were being dealt with, it was found a matter of very great difficulty, even an impossibility to prepare these maps with accuracy. The configuration of the ground, the aspect, and consequently the composition of the stock were found to vary so continually and so abruptly that to show these variations in detail was a hopeless task.

Moreover, it was found that these maps even when carefully and well done, did not, in the absence of descriptions of blocks and compartments, without enumeration surveys, afford sufficient data to enable one to draw up a satisfactory scheme of working. Thus the quantity of sound mature timber available remained altogether unknown; and even the areas in which fellings were advisable could not be distinguished. The long lines used to show the presence of mature timber, for instance in one ravine, stretched perforce over several adjoining ones in which perhaps there was no timber present; and whether the mature timber, the presence of which was thus denoted was sound or unsound, or whether it was advisable to fell it and in what quantity, there was nothing to show. The utility of such maps for irregularly stocked forests situated on broken hilly ground is therefore very doubtful, and their preparation may well be confined to more regularly stocked forests of trees of even age, where the composition and density of the coupe and the dominant age classes can be with advantage and accuracy laid down on the map.

8. It was not until much valuable time had been expended that it was decided that "Improvement Fellings" here did not satisfactorily meet the case; that there was available a considerable amount of sound mature timber, and that it was desirable to ascertain exactly where this was situated and in what quantity; that the bulk of material which "Improvement Fellings" would yield was unsaleable; that the areas to be felled over annually would be much too large, and that the only proper method of treatment was that of "selection." Accordingly enumeration surveys were carried out over all places in which mature timber, not all already enumerated, was thought to be present; and here again the stock maps first made proved of little use, and many places were enumerated which were not worth the time and money expended on them.

4. It was then that the preparation of the more useful stock maps, made for the working-plans of the Garhwal and Ganges Divisions, was taken in hand, and at the same time a description of the stock in each compartment was drawn up. The chief object aimed at in these stock maps was to show where the sound mature timber was situated, and consequently where enumeration surveys could be made with advantage; and after that to show roughly the distribution of the main types of forest growth throughout the area dealt with; and thus to enable one to classify the forests according to the method of treatment which might best be applied to each differently constituted type. The types or classes of forest recognised were—

A.—Sal forests with trees of all ages in which sound mature timber is present.

BI.—Sal forest in which there is very little sound mature timber remaining.

BII.—Sal forests principally composed of trees of the younger classes.

C.—Forest in which owing to the present condition of the stock felling cannot be recommended.

5. The stock map work should be done before the enumeration surveys are undertaken, and should be well checked by the officer in charge. It does not as a rule answer to do the stock mapping at the same time as the enumeration work, as the man in charge, anxious to get through the enumeration work as quickly as he can, or to get out of it where possible, is tempted to classify as B forest which should be classified as A.

6. In the Garhwal Division we fell into a mistake exactly in the opposite direction to that made in Kumaun, and enumerated nearly the whole area of the Kotah range before conclusions were arrived at that here "Improvement fellings" and an indefinite volume of material to be removed in them, according to the needs of the growing stock, was the correct method of treatment. But in this case there was not much cause for regret; inasmuch as the results of enumeration surveys cannot fail to be instructive and useful even where, owing to the state of the forest growth, they may not be actually required.

7. From what has been noted above it is to be concluded that it is a matter of the first importance as well as of great difficulty to settle the best method of examination of an area (especially if this be large and irregularly stocked) for which a working-plan is in contemplation. In the case of the Kumaun Division a great part of the work done during the first season was wasted.

ENUMERATION SURVEYS.

8. The knowledge which we already possessed of the composition of the sal forests of Kumaun and Garhwal, gained in the preparations of and from the enumeration surveys made for Mr. Hearle's working-plan for the Nindhaur valley and Mr. Dansey's working-plan for the north Patli Dun, was considerable. In the enumeration work for these plans all sal and sain trees above 18 inches in girth had been counted. The results showed that nearly everywhere the 3rd and 4th class sal trees were very largely in excess of the 1st and 2nd class trees. Thus in the Nindhaur working circle the figures were :—

Sal.

1st class.	2nd class.	3rd class.	4th class.
27,435	61,210	169,668	249,973

and in the North Patli Dun—

Sal.

1st class.	2nd class.	3rd class.	4th class.
86,204	167,625	378,543	644,584

From this it was evident that the future of the forests was assured, and that after the lapse of a period sufficiently long to allow the 2nd class trees to become mature, the yield of the forests would be very largely increased. This being so, in the enumeration surveys made for the new plans it was considered sufficient to count the 1st and 2nd class trees only, these forming the stock of material, mature or approaching maturity, which we were justified in considering available for consumption during the period required for the constitution of a fresh stock of mature trees.

9. The best number of men for an enumeration party was found to be 12, *viz.*, two men to keep the line on either side, eight gaugemen to measure and call out the trees and two recorders to write the trees down as they are called out. As many as 20 men in line were tried, but it was found that the long line soon becomes unmanageable, and that it is not advisable to employ more than 10 men in line with the two recorders to look after them. A little drilling of the line soon brings the men into order. The two linemen should keep calling to each other so that they may keep a proper distance apart; they should lightly blaze the trees as they pass so that there be no difficulty in finding the line again when required. The gaugemen should be taught to keep touch by the right or left as the case may be. They should march about a chain apart from each other, but this distance will vary with the density of the forest. Each tree as it is found is measured at about breast height by the gaugemen, and blazed with an axe at the place where it is measured. The gauges are divided into parts 6 inches long, each part being a different colour and representing the different classes, *viz.*—

1st Class.	2nd Class.	3rd Class.	4th Class.
Over 6' in girth	4'6" to 6' in girth	3' to 4'6" in girth	1'6" to 3' in girth.

so that the gaugeman has but to call out the kind of tree, and the colour shown on the measuring gauge; he also calls out whether the tree is sound or not. The men should be made to call out the tree in a loud voice, and the recorder to repeat the particulars after them; showing that they have correctly recorded the tree called out. The best method of recording the trees was found to be by dots thus : × : each group forming 10 trees. The blazes on the trees should be made lightly on the bark, sufficiently deep

for the mark to remain for some time, but not sufficient to cause a wound to the tree. The coolies are very fond of making deep cuts into the wood if not prevented. The blazes on the trees should be made on the side, in the direction of which the party is advancing, so that a glance behind shows whether any particular tree has been counted or not.

In hilly ground the line should advance along the contours of the slopes and not up and down, as in this manner the walking is easier and more work can be done.

It was found that working with 12 men in the manner above indicated, for eight hours a day, an average area of 100 acres could be surveyed.

10. To ensure the accuracy of enumeration surveys is a difficult matter. There are many causes of error such as—

- (a) mistakes may be made in the boundaries of compartments ;
- (b) trees are left out owing to the men in the line getting too far apart ;
- (c) mistakes are made in classifying the trees into sound and unsound ;
- (d) forest, the trees in which ought to be counted, is omitted altogether, owing to wrong classification, or laziness ;
- (e) the men for pure mischief will call out trees which do not exist.

11. In order to test the accuracy of the work check surveys must be frequently carried out. To enable these to be done without too much expense of money or time, the forest should be divided up into compartments or sub-compartments of not more than 300 acres; better even smaller; for to check a compartment of 300 acres will take at least three days, when there are many hands at work. It is a good plan to have a separate gang of men under a reliable officer employed entirely on checking the work of others.

12. The classification of the trees into sound and unsound is a fertile cause of error, and this alone may often vitiate the calculations made in a working-plan. A tree which appears perfectly sound from outside, and which rings true to the blow of an axe, not unfrequently proves rotten and useless when cut. One can but continually impress upon the men the importance of correctly classifying the trees. Another point is that trees though not hollow may be so crooked and stunted as to be quite useless for timber ; all such trees should be written down unsound.

13. The pay of line and gaugemen was Rs. 5 a month during the cold weather, November to March, and Rs. 6 during April and May, during which months it is very difficult to keep the work going. The recorders were paid Rs. 8 to Rs. 10 a month. When a forest ranger was in charge he himself acted as a recorder.

The average expenditure per 100 acres enumerated has been calculated to have been Rs. 3-12-0, exclusive of the salaries of forest rangers and other subordinates employed.

NAINI TAL : } F. B. BRYANT,
The 5th June 1896. } Dy. Consr. of Forests, Kumaun Divn.,

Woods suitable for the Manufacture of Matches

From—H. D. BANERJEE, Secretary to the Bengal Safety Match Manufacturing Company, Limited, to the Conservator of Forests, Bengal.

With reference to your enquiry No. 57-T-P.—M., dated the 1st instant, and its reminder No. 57-T. P. M.—R. I., dated the 15th instant, I have the pleasure to inform you that, out of the various samples of timber so kindly sent us by your constituents, only the following have been found suitable for the purpose of manufacturing matches with ; and the supply rates of them only are, therefore, earnestly requested for :—

Name of timber.	Despatched by	
<i>Elæocarpus robustus</i> ...	Deputy Conservator, Kurseong Division, Sukna.	
<i>Evodia fraxinifolia</i> ..	Ditto.	Ditto.
<i>Abies Webbiana</i> ...	Forester, Singalila Range.	Ditto.
<i>Juniperus recurva</i> ...	Ditto	Ditto
<i>Alnus nepalensis</i> ...	Forest Ranger, Goompahar Range.	
<i>Magnolia Campbellii</i> ...	Ditto.	Ditto.
<i>Heptapleurum elatum</i> ...	Range Officer, Senechal Range.	
<i>Sambucus javanica</i> ...	Ditto.	Ditto.
<i>Symplocos lucida</i> ...	Ditto.	Ditto.
Ditto <i>ramosissima</i> ...	Ditto.	Ditto.
<i>Gmelina arborea</i> ...	Forest Rangers, Porahat Range & Samta Range.	

Provident Fund for Forest Officers.

From—The Conservator of Forests, Hyderabad Assigned Districts, to the Comptroller, India Treasuries, Calcutta.—Dated 11th July 1896.

With reference to Government of India, Finance and Commerce Resolution No. 2881 P., dated 1st July 1896, I have the honour to enquire whether the compound interest referred to in the Forest Officers Provident Fund rule II (4) will be credited annually on the monthly payments; *i. e.*, suppose interest is credited on 1st July 1897, will the payment of 1st August be allowed interest for 11 months; 1st September for 10 months; 1st October for 9 months, and so on, or what will be the procedure as to crediting interest?

I ask as the point is one of interest to all the Forest officers in Berar, and when issuing the Resolution I wish to give them definite information as to how interest will be credited.

From—The Comptroller of India Treasuries, to Conservator of Forests, Hyderabad Assigned Districts.—Dated 17th July 1896.

With reference to your letter dated 11th July 1896, I have the honour to state that interest will be calculated monthly upon the minimum balance at credit of subscribers between the close of the 4th day and the end of the month, but will not be added to

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the principal until the end of the Official year as laid down in Rule XI of the Fund Rules issued with Financial Resolution No. 2881 P., dated 1st July 1896.

A sample form showing the method of calculating interest is herewith enclosed for your information.

Name _____

MONTH.	Amount of monthly deposit.			W i t h - drawals.			Monthly balance on which in- terest is calculated.			Interest at 4 p. c. per annum.		
Balance of last year Brought forward												
August 1896	...	25	...	...	...	...	25	...	...	...	1	4
September 1896	...	25	...	...	...	...	50	...	...	...	2	8
October "	...	25	...	10	...	...	65	...	...	...	3	5
November "	...	25	...	...	...	...	90	...	...	...	4	9
December "	...	25	...	15	100	5	4
January 1897	...	25	125	6	8
February "	...	25	150	8	...
March "	...	25	175	9	4
Rs. ...	200	25	2	9	6

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Forest Administration in the Central Provinces.

The writer of the article on the Central Provinces Forest Administration, which appeared in the *Forester* for August, has made out an apparently good case for the belief that is in him, that all our financial shortcomings are due to the substitution of localized and systematic fellings for the old unregulated and unscientific methods of former years. But although I agree with a good deal of what "C" writes on this subject, it is desirable that certain not unimportant inaccuracies should be pointed out in his figures, which tend to mislead, and that in some other matters his article should not be allowed to pass unchallenged.

As the question argued is principally one of diminishing receipts and is not immediately concerned with our unavoidable but increasing expenditure, I will, for the present, leave all figures relating to the latter out of the discussion. The statement of receipts given in "C's" article is as follows:—

1892-93	=	Rs.	14,48,508
1893-94	=	"	10,92,618
1894-95	=	"	10,43,306

According to which, the year 1893-94 exhibited a decrease of revenue equal to Rs. 3,55,890, and the year 1894-95 a further decrease of Rs. 49,312.

The actual state of affairs is bad enough, but our position is not quite so bad as above represented. "C" has been too superficial in his study of those interesting annual reports and has no doubt inadvertently made the mistake of quoting for 1892-93 the figures for the *15 months* that went to make up the above forest year, as will be remembered by all Forest officers, and has then compared them with the figures of the two subsequent years, which contained only the normal *12 months* each. The comparison is, of course, misleading and shows a much larger falling off in gross receipts than has actually occurred. If, instead of the abnormal forest year 1892-93, the figures of the financial year had been used for comparison, as they should have been, we should find the following results:—

Financial year 1892-93	=	Rs.	12,30,854
Forest year 1893-94	=	"	10,92,618
Forest year 1894-95	=	"	10,43,306

which shows a total falling off in receipts, during the two latter years, of Rs. 1,87,548, instead of Rs. 4,05,202, as exhibited in "C's" statement, or rather less than half this latter amount.

Having made this very necessary correction, I will now return to the chief subject of "C's" discourse. It was inevitable that such a radical change of system as has taken place in these Provinces should have an immediate and depressing effect on the revenue, and the reason for such results is not difficult to explain. Previous to 1893-94, almost all the Government forests were available for supplying the public requirements. A purchaser of timber having paid for his license could enter a forest and pick and choose here, there and everywhere, provided he restricted his operations to the special kinds of trees entered in his license. Time being of no great importance to him, he often wandered over extensive areas searching for his requirements and always taking care to select the best available trees in the most accessible situations. This procedure carried out over a considerable period necessarily caused the removal of the best material, and as the felling was almost invariably badly done, a high stump being left above ground, it resulted that our forests, especially in accessible localities, gradually became degraded in character until in many places they are now composed of growth, fit only for firewood. Under the present dispensation, however, all this has been altered. The forest reserves have been divided up into working circles, each of which again has been subdivided into 15, 20 or 30 compartments according to the years of the rotation fixed for the locality. But this latter is greatly dependant on the grazing question which is of primary importance in these provinces and varies correspondingly with the pressure on the forests for this requirement. Where, for instance, few cattle are dependant on the Government forest, it is practicable to reduce the rotation to the lowest possible limit required for providing a sufficient period of close protection for the areas that have been felled over; but on the other hand where cattle are very numerous, as in the majority of our forests, the rotation has to be extended to obtain the same desideratum. Most of our circles are divided into 30 compartments because it has been considered that at least 10 years of close protection are required for establishing the coppice re-growth and ensuring a certain amount of seedling reproduction, and because we cannot, owing to the grazing pressure, afford to close more than one-third of the forest area to cattle. The compartments are opened each year according to a fixed plan, therefore, only 1-30th of the area formerly open to a purchaser of timber is now available for his felling operations. Add to this fact that the compartment may be situated in forest that has suffered from the selection system above described and that the purchaser is no longer

allowed to fell his trees according to old methods, and it will easily be understood that in many cases he finds it difficult or impossible to obtain exactly what he wants, or becomes disgusted with the inferior quality of the material available and the extra trouble and expense entailed in exploiting it. It may perhaps be argued that, under the above circumstances, those parts of the forest should be first opened for working that have escaped the old drastic methods, and are still capable of supplying a fair quality of good material, but it may be answered that, such areas are often situated in relatively inaccessible situations and that if they had been selected for working, there would have been absolutely no demand on them, and the fall in revenue would have been even greater than it has been. We do endeavour to open the best areas first and to keep the worst part of the forest for the closing years of the rotation, but we have to temper our sylvicultural regulations with considerations connected with the general convenience of the people and not altogether unconnected with financial exigencies.

It is quite certain, in my opinion, therefore, that the change of system described above is responsible for a considerable fall of revenue, and it seems inevitable that this loss must be permanent for some considerable time ; in fact, until the accessible forests are improved, or until the more inaccessible forests are opened up by roads, which again, in this hilly country, will entail a large initial outlay. But while so far agreeing with "C's" remarks in this connection, I desire to point out that he has placed too much emphasis on this particular cause of loss, and has ignored at least an equally important one which I will now briefly touch on. Previous to 1891, no malguzar in these Provinces could fell timber from his estate without first obtaining permission from the Deputy Commissioner, and this permission was not accorded until the forest had been inspected by a Forest official and reported on as being able to supply the requisition. There was often some trouble and always much delay in obtaining the necessary permission, and complaints were not infrequent that the Forest official submitted incorrect reports to the effect that the forest in question was not able to yield, without injury, the quantity of timber asked for. The consequence of the restrictive rules was that comparatively few sales took place from malguzari areas.

But in October 1891, certain new rules were prescribed by the Local Government in Notification No. 7484, which practically conceded to malguzars the right to cut and sell their forest produce, provided certain fruit trees were respected and also provided certain specified sylvicultural requirements were complied with.

By this notification, all the private waste of the Provinces or about 12,000 square miles was at once thrown open to the public for trading purposes, and although such lands, as

a rule, bore forest of inferior character, it could not but happen that extensive areas were found capable of supplying the public demand, especially as their situation is frequently more accessible than that of the Government reserves. Couple with this liberal trading permission the fact that the period 1895-96 has been one of exceptional agricultural depression in most of the districts of the Central Provinces where many malguzars have found it difficult to meet the land revenue demands on their villages, and it can be understood that the newly acquired right must have been worked with a will and in some instances with more energy than was desirable for the future welfare of the forests. The new rules, if they could be enforced are sufficiently protective in their prescriptions to ensure the permanency of the private forest, but the due enforcement of the rules is rendered very difficult by the want of proper inspection and the temptation of the landlord to exploit his property in the quickest possible time. To effect this latter object, he will, if he can obtain the Deputy Commissioner's permission, farm his forest to a contractor, and under nearly all circumstances is ready to take what he can get for his building poles and fuel. And in many cases, as his land lies beyond the ken of any Forest official, nothing is done to check the wasteful and discriminate working that is surely if slowly destroying the forest and curtailing the supplies on which the future convenience of the village is largely dependant. It is true that the village officials and some revenue subordinates are also expected to report on the working of these rules and to bring to notice all irregularities especially in connection with the overworking of the forests, but such officials are wanting in technical knowledge, and would probably not notice anything worthy of report, until the damage was done and the forest ruined; moreover their relations with the malguzars and owners of forest are not calculated to encourage much useful reporting in this connection. It is quite certain that the private forests of these Provinces have been in recent years and are now being very freely worked under the concession granted in 1891, and it is easily conceivable that as many of such forests are more accessible than the Government reserves as they are free of all the necessary but inconvenient restrictions insisted on by the Forest Department and as they offer material at cheaper rates, a considerable amount of trade has been diverted towards them that formerly was supplied from our forest; and in my opinion, a larger portion of the total decrease in our revenue, under all heads except grazing, is due to this cause than to any other. It is impossible to put this loss into figures, but I should feel justified in asserting that it is accountable for not less than half the total amount.

If to the two above fruitful but incalculable causes of a diminishing revenue is added the fact, that nearly a lakh of rupees has been remitted by Government in pursuance of their generous

policy in connection with grazing dues, that a further loss of several thousand rupees has been suffered under fuel and bamboos by a similar reduction of rates, and that loss of revenue must have resulted from the late bad seasons and from the disforestation or transfer to the Revenue Department of extensive areas of reserved forest, it need not be matter for wonder that our accounts have recently exhibited such very unsatisfactory results. And further, if with all these causes for a diminishing revenue, we have simultaneously been obliged to increase our expenditure under surveys, working plans, buildings, roads, and fire protection, to the tune of $1\frac{1}{2}$ lakhs of rupees annually, it becomes fairly clear why our once fat surplus is rapidly melting away to the vanishing point, and things are not what they were. Some of these back losses, however, will come back to Government either through the Forest or Land Revenue Department. Harvests cannot always be so meagre as they have been of late years and any improvement in this respect will probably result in increased timber sales. Private forests will year by year grow less able to supply the present trade demand on them, which will then be diverted again to the Government forests, while the loss of forest revenue that must surely result from the gradual settlement of the 3,000 square miles which have been cut away from the reserves for purposes of cultivation, will be more than recovered in the shape of land rents and the increased development of the country that such an access of the cultivated area must entail. And while there is every reason to think that some portion of the old revenue will be recovered, it is certain that the present large annual outlay on surveys and buildings will soon cease, when the forest surplus will benefit by over a lakh of rupees in consequence.

Before closing this long and, I fear, tedious letter, I should like to make a few remarks in regard to "C's" statement, that if receipts do not rapidly increase after the year 1897, it will prove that the working plans now being prepared are not suitable for supplying the wants of the people and the local market. It by no means follows that this would be a correct inference to draw from a stationary revenue, for as explained in my above remarks in connection with the effects of the new working system on receipts and on the new policy in regard to the working of private forests, it is inevitable that the results of these two factors must be permanent for some considerable time. In preparing plans, it is sometimes incumbent on us, owing to grazing requirements, to fix rotations that are longer than absolutely required for producing the class of wood in demand, and by lengthening the rotation we have necessarily to curtail the area that may be opened for working each year, which in some cases has a restricting effect on sales, especially of building wood. But were we to shorten the rotations, one of two things would become necessary, either we should be obliged to curtail the area open for

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grazing, which would cause much inconvenience to the people, or we should have to shorten the period of close protection afforded by the plans to areas that have been felled over, which would be sylviculturally hazardous. We cannot always make plans that will meet all the requirements of the local markets; all we can do is to endeavour to provide such requirements to the best of our ability, and we anticipate that in several localities the introduction of systematic working will certainly cause an immediate and relatively permanent loss of revenue, owing to the capability of the annual compartments being much less than the previous demand on the forest.

J. McKEE,
Conservator of Forests,
Southern Circle, C. P.

Working Plans in the Southern Circle of Bombay.

It appears desirable to correct some of the statements made by "Organisation" in the July number of the *Forester*. As regards the Pen, Panwel, and Nagothna ranges of Colaba, section 7 of the above article is incorrect. The forests are principally mixed forests, teak predominating in the more accessible places, and other species in the remoter parts. The average diameter to which the trees grow is 12" to 18" at breast height according to the locality. The height is seldom less than 25 ft. It averages perhaps 35 ft. for teak and 40 ft. for the chief other species. In many of the remote parts the height and diameter growth is far greater. The forests of Aghan, Koregaon, and those near the Manikgad Hill, in Nagothna, Pen, and Panwel may be cited as instances. In Aghan I have found stumps of teak trees, cut two or three feet above the ground, over 200 years old, and coppicing very vigorously. Throughout these three ranges teak trees of large diameter coppice as well as, if not better than, smaller ones. Owing to the want of sufficient shady trees in the dry season, the soil is very dry, and *ceteris paribus* the larger the trees, the better their chance of coppicing when felled. The forests have been worked in two ways—

- (1) by fellings on the clean cutting system;
- (2) by selection fellings.

The effect of the first system has been to nearly stop natural regeneration. That of the second has been to get rid of nearly all the best trees. Sometimes teak alone was cut first in the coupes, the other species being removed the next year, to the detriment of the teak coppice. The word mature, as used in section 8, applied to trees of 4" diameter, is almost as out of place as it would be in Kanara or Burma.

As far as I am aware, no data were collected for Nagothna, as mentioned in para 11, except by me. Certainly none were collected in either Pen or Panwel. In these three ranges I examined 550 teak logs, and the results were recorded in the Divisional Office Colaba. The best rotation, as far as quantity was concerned, worked out generally in the different compartments at from 50 to 75 years, speaking roughly ; while the value of the older material was proportionally much greater than that of younger wood. The supply of large material was getting smaller and that of small rafters was increasing, owing to cuttings outside forest limits. In addition, the want of shade for natural regeneration, the loss of trees at each time of coppicing, and other considerations, all point to the advisability of a fairly long rotation. In places where the shade trees have not all disappeared there are still many young seedlings to be found, as at Belapur and elsewhere. Accordingly, the necessity of preserving such trees for shade, as well as teak trees for seed, was pointed out. Government, taking all things into consideration, refused to sanction a shorter rotation than 40 years, and further ordered that standards should be kept. To anyone acquainted with both Colaba and Thana forests, the benefits of keeping standards are apparent. Perhaps "Organisation" can let us know how many, and what kinds of standards are now being reserved in the Colaba coupes. As a rule, softwood trees which are elsewhere not larger than hardwoods, are in Colaba much greater in height, owing to the destruction of the best of the latter. To describe the Colaba forests as "rafter forests" is as incorrect as to describe the Kanara or other high-class forests, as such. The few very large trees found here and there show what will grow in Colaba, if allowed, while the diseased trees on the borders of cultivation, and the extensive grass hills where there is no forest left, are not a guide, but a serious warning.

(To be continued.)

C. HODGSON.

3rd September 1896.

White Ants.

BY JAMES CLEGHORN, ESQ.

In 1888, while in the Orissa district, I took some interest in trying to work out the complete natural history of the White Ant pest, for if this is not done, it is almost impossible to suggest practical remedies. It is a mistake to try remedies and nostrums which, from half knowledge of the subject or absence of knowledge, generally result in the remedy proving more harmful than the disease. I was disturbed in my researches, and having since been unable to pursue the thread of my enquiries, I fear the opportunity for completing them will not be mine. But as I gather that the White Ant pest is at present making itself felt in Assam and other districts, and at the Society's Gardens, I propose, with the permission of the Hon'ble President, to place before the meeting the following notes, which, though incomplete, may be of use if only by stimulating further enquiry.

The Queens.—Two are generally found in one cell, with one masked Queen as a reserve, but occasionally three fully developed Queens are met with in a cell, in addition to the reserve Queen. The natives always ignore the presence of the masked Queen, but when two fully developed Queens are found, they are styled King and Queen; when three are discovered they are called King, Queen and Prime Minister! The Queen's cell consists of a chamber with a flat floor and domed roof; the entrances to, and exits from it are only large enough to admit of the free passage of the ordinary White Ant, and the communication is always through the floor. The largest Queen I discovered amongst forty ant-hills of various sizes, was four inches long by half an inch in diameter. Some Mahomedans in Orissa use the Queens for medicinal purposes, swallowing them alive. When the Queens die naturally, another cell is built, adjoining the old one, and new Queens are enclosed. But when the Queens die out of season, the reserve is made to take the place of the defunct sovereigns. If one out of the two Queens dies, and the reserve Queen un.masks, she demolishes the remaining Queen before her transformation is complete. Knowing the pugnacious character of these Queens during the process of unmasking, it has puzzled me how two of them can be made to occupy one cell. This is an important detail, as are all details in investigations tending to the destruction of insect pests.

The Masked Queen.—This creature is the ordinary flying White Ant, so numerous at the beginning of the rains, but minus wings. It is said that the females shed their wings after a flight of a few feet only, whereas the males soar to unknown heights, and disappear from the locality. My observation shewed me that, when unmasking, the reserve Queen first changes from a brown to a cream-coloured grub, with a pair of formidable nippers, and, in a state of quivering excitement, perambulates the cell with nippers extended, ready for a death struggle with anything and everything in the apartment. In one case I discovered she had burst up one old Queen, and had inflicted eleven wounds on the aged monarch's companion. After having demolished everything in her cell, the new Queen quiets down and attendants return and clear up the remains of the defunct Queens, making everything snug for the complete development of the new ruler. The provision of cells with reserve Queens is evidently a provision against the contingency of unseasonable death among the old Queens. But this reserve Queen never has a new cell built for her, as is the case when new Queens are selected in season. If the Queens die out of season, without provision having been made for a reserve Queen, the ant-hill is abandoned, or the community dies out, and the fungoid spores, which the ants cultivate for food, spread, until the growth covers the hill which is a sign that it has been abandoned.

Eggs.—The new Queen's development is fairly rapid, and even when only an inch long, and as thick as a slate pencil, she

commences laying eggs, which are oval in shape, and transparent, with a soft cover, slightly tinged with brown.

These eggs accumulate in a small heap, and are carried away to the nurseries which contain combs, stocked with fungoid spores. There they are deposited in indiscriminate heaps. The young, on hatching out, crawl away from the heaps, and distribute themselves among the combs, which are of various sizes, and fit loosely in compartments corresponding to their size and shape. The passages to these compartments are guarded by the soldier ants. The combs appear to be constructed of chewed wood, or some material suitable for propagating spherical fungoid spores which appear to constitute the food of young ants found in all stages of development in the same comb. If these combs with the spores are exposed to light, and kept shaded from excessive heat, very handsome fungoid growths will develop.

The Soldier Ant.—This is a formidable customer with a reddish, brown head, furnished with retroussé nippers, and a cream coloured body. His function is apparently to keep watch and ward over the nurseries, and cater for the rising generation.

The Overseer Ant—Is much like the soldier, but has a larger head, while its nippers turn inwards towards its face which are thin and flat, and provided with cutting edges terminating in a point. He seems to direct operations, and has been observed to pull down bad work, and strengthen weak places. He has always in attendance a gang of workers, has never been found in the nursery, but is allowed occasional admittance into the Queen's cell. He is very pugnacious, and has been seen to drive his nippers into the Queen's body; then the lady, by a muscular movement, summons her attendants, who muster in force and make him "move on."

Workers and Attendants.—These have small heads, with transparent abdomen, and always appear to be full of food. They swarm over the Queen's body, intently examining every part with their nippers and feelers, and when one of them discovers anything unusual, that august body indulges in a muscular movement, then all the ants suddenly evince an absorbing interest in that particular spot. The object of this incessant examination is probably to prevent the Queen from being successfully attacked by parasites which infest the hills in great numbers.

Parasites.—Immense numbers of small flies are bred in White Ants' nests, and in the combs I have observed a spider which hides its identity by attaching to its body pieces of comb and spores. But my researches have, so far, not enabled me to suggest any parasite which might be utilized in exterminating the White Ant. In fact, I do not believe in the utility of employing parasites, as it seems to me a question in the economy of nature sustaining the necessary balance, and would probably lead to the development of the species they are intended to destroy.

To the question as to whether the White Ant in garden, field or forest is an enemy or friend, the writer would be inclined to include him in the latter category, *when kept in his proper place*. But as he is popularly considered a foe, a few hints on how to deal with him, and the grubs which, in many instances, are the destructive agents for which the White Ant is made the scapegoat, may not be out of place.

(1) As each ant-hill is dependent on its Queens, and as there is never more than *one* Queen's cell in each hill, that cell should be found, and the Queens, *together with the reserve Queen*, should be destroyed during the months from March to November, when there is no stock of new Queens available, and with a little practice, these cells can be located. For instance, in Orissa, we used to look for them just above ordinary flood level, and, on digging to a depth of about eight inches on the north-west face of the hill, we used to discover the cell. But the operations will never be successful unless the masked Queen, who appears to be very intelligent, and quick at concealing herself, is secured and also destroyed. If she escapes the search, she is made to continue the work, until the proper season comes round again for securing new Queens.

(2) I have kept woodwork in the river bed free from attacks of White Ants, by watering it with a 5 per cent. solution of *common salt*; but fancy any deliquescent salt would be strong enough to answer the purpose, if applied in a 3 per cent. solution.

(3) The juice of the Aloe plant from which fibre is made, if applied *fresh*, will destroy ant-hills; but if allowed to ferment is useless.

(4) When fungoid growths appear on the outside of ant-hills, it is a sign that the nest has been abandoned. Some use might be made of this observation.

(5) White Ants will never attack healthy growing plants, nor will they attack a piece of rope which is kept properly tightened. They will build passages over a tightened rope, through which they will carry away other material, and, in like manner, they will build passages up the stems of plants in order to reach decayed or decaying matter, and will probably remove the surface of the bark along these passages, which surface is practically dead.

(6) When a plant has been cut round just below ground level by a grub belonging to a species of beetle, it is then that White Ants are ready to carry away the result of the grub's work; the latter having taken three or four weeks to destroy the plant, moves off, and the White Ants are the only destructive agents which appear on a cursory examination. Now, if on the first signs of a plant drooping, the ground is dug up to a depth of six inches around it, and a careful examination is made of the vicinity, a grub, an inch or so in length, will be discovered.

(7) In the cultivation of the mulberry bush I found this grub caused much damage, but it was successfully dealt with by

digging a small circular trench, 9 inches from the stem, in which was laid a train of sulphate of iron and lime. The trench should be about three inches deep and an inch wide, and there should be just sufficient of this mixture to make a train.

(8) In pruning the mulberry bushes according to methods laid down in books, I found that a small beetle promptly established itself in the pith of the branch exposed by the cut, and, working down to the stem, eventually killed the plant. But, just before the plant died, the beetle would make off, and the White Ant succeeding him was unjustly blamed for the damage. To obviate this, I had to resort to pruning flush with the ground, covering each operation over with ash or dried earth.

In a discussion that followed the reading of the paper, the Hon'ble Mr. P. Playfair fully endorsed the theory put forward by Mr. Cleghorn, that when White Ants are discovered attacking a growing plant, they should be regarded as evidence of previous damage committed by the cut worm, pith beetle, and similar pests, which by cutting the tap root and boring into the stem, kill the tree, thus preparing the way for further destruction by the White Ant.

The Secretary stated that the grub of the beetle had been found in leaf mould, dead branches, old trunks, at the base of dead trees and in old cow-dung, and made over to Mr. Cleghorn several grubs found at the bases of three *Araucarias* lately blown down. At the base of each *Araucaria* from ten to thirty of these grubs were found. They had bored into and through the stem, leaving a lot of dead wood on each side of the borings and demolishing the pith; White Ants had thus gained an entrance to the pith which they had destroyed, in one case to a height of 18 feet and in the others 13 feet and 7 feet respectively.

To obviate any error, these grubs have been carefully removed from the mould in which Mr. Cleghorn received them, and placed in some sterilized mould with fresh cut wood, so that when the *imago* is obtained, it will be identified and means for destruction worked out.—*Journal of the Agri-Horticultural Society of India.*

A few Notes on the Palmyrah Palm.

The Palmyrah palm (*Borassus flabelliformis*) grows exceedingly well in the dry low country of Ceylon, and especially in the Northern Province on the peninsula. The question of Government taking up the cultivation through the Forest Department has been under consideration for some time, on account of the large number of trees felled annually for export to India, and for the large local demand. This export has been so large that a fear was expressed that the supply might become exhausted,

and as the natives depend largely on their trees as a means of subsistence, this would have been a very serious matter.

In our opinion, this danger does not exist, but it would nevertheless be sound policy for Government to have a large reserve in Palmyrahs not only in case of such a thing happening but because there are large tracts of scrub land, which will not grow good forest, and which are eminently suited for the cultivation of Palmyrah palm; as an example, we might mention the large tract of land adjoining the Mendakalaar in the Punakari Division.

The Palmyrah is unisexual, and the male tree is not nearly so valuable as the female, not only because it yields no fruit but because the wood is considered inferior. This palm comes into bearing at from 15 to 20 years and is considered fit for the axe at 80 years of age. It does not fruit all the year round, but gives one crop from August to October. The fruit contains 1, 2 or 3 seeds; in general those with 3 seeds predominate and those with one seed are much rarer. The Tamils call the fruit with one nut "kudavan," those with two nuts "irakali," those with three nuts "mookali." And an average crop is 50 fruits per tree, worth about 25 cents, the male tree being worth about 3 cents per annum from leaves sold.

If, however, the tree can be used for drawing toddy, the value per annum is much increased, a female tree being worth from 62 to 75 cents and a male tree 18 to 25 cents each. Taking toddy from the tree is, however, very exhausting, and we cannot recommend it except where there are a much larger percentage of male trees than are required for fertilizing the flowers of the female trees.

The percentage of male to female trees in a field would therefore greatly affect the value to be expected per annum. Estimates roughly made quoted 40 female to 60 male, again 50 female to 50 male; to test the accuracy of these estimates a large number of Palmyrahs were counted with the following result:— Out of a total of 488 Palmyrahs counted, we found 296 female as against 192 male giving in a hundred 60 female to 40 male trees, but as we also found in these clumps a large number of stumps, all of which were probably female trees, cut for timber, we are much inclined to anticipate that in a clearing the female trees would be as 2 to 1 of the males.

Nothing spoils the Palmyrah palms so much as being grazed by cattle, and it is most important that the clearings should be securely fenced, as if once cattle graze the palm in its youth, it takes years to recoup.

An extraordinary estimate for planting Palmyrah is given by Mr. Vincent and quoted by Messrs. Ferguson in their handbook for 1893.

"The cultivation is of the easiest in light sandy soil. Make a hole, put in the nut and fence from cattle for 3 years, costing altogether Rs. 3 per acre; at the end of 10 years rents for

jaggery would pay well ; and at the end of 80 years, the value of timber should be Rs. 525 per acre ; total outlay in 10 years say Rs. 14 per acre."

We regret that the figures are not given in detail, especially the number of trees to be put in per acre. Our opinion is that the tree should be planted 6' x 6' giving 1,210 trees per acre if planted alone, though we should much like to see date-palms given a fair chance in Ceylon. However, we must confess that this estimate is quite beyond us. Our own opinion is that it will cost about Rs. 80 per acre. The low scrub would have to be cleared and burnt. A fence, capable of not only keeping out cattle, but elephants, will be required together with a deep drain all round. Close supervision is necessary or the natives will come and dig up the young plants to eat the roots, and wells will be necessary, for the plants will require watering.

Ceylon Forester.

* Timbers in the Straits Settlements.

BY MR. HENRY J. CHILD.

The following remarks are based upon practical experience, and from frequent visits to the timber ponds and saw mills about Singapore, as well as information obtained from reliable sources during five years' residence at this station.

The timbers will be referred to in the order of their durability and use, those of equal value being classed together.

Belian, Tampenis, and Krangi.—These three timbers are really ironwoods, and are practically indestructible, as the white-ant will not touch them. They are scarce, as the Chinese cut and export all *Belian* and *Krangi* to China for coffins, but at present a supply of *Belian* can be obtained from Sarawak. *Belian* grows in swampy forests near rivers, and the tree is of large size. The timber is of a drab colour when first cut, but turns darker on exposure, and is close-grained and very difficult to work. *Tampenis* is of moderate size and a rich brown colour, close-grained, very heavy, and becomes extremely hard with age. It is now very scarce, as it is only found in young trees, and is generally used for tool handles and dowels. It was used for all buildings erected in Singapore 30 years ago, but the particular forest from which it was obtained has now disappeared, having been cut down for timber. *Krangi* is a large tree growing to a height of 60 ft. with a diameter of 4 ft., but

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is very uncommon in forests. The timber, which is of a dark colour and finely veined, is very hard and durable.

Ballow, Dammar Laut, and Rassak Merah.—These are all sound timber, resisting the white-ant if of good quality and well seasoned, and standing wet and exposure to sun and weather. *Ballow* is a large tree growing to a height from 60 ft. to 100 ft., and to a diameter of 6 ft., and has only a small amount of sapwood. Very sound and good timber is found in logs 12 in. to 15 in. square, the large logs often having large holes or hollows near the centre. The timber is of a light brown colour and darkens with exposure; it is hard and close-grained, easy to work, however, when fresh cut from the log, but more difficult afterwards, as the surface hardens on exposure, and after planing feels rough. It cannot be used in small scantlings on account of its liability to warp. The timber is becoming more scarce every year on account of its being cut down and not re-planted, and the tree being of slow growth. There are inferior timbers brought into the Singapore market and called *Ballow*, but generally they are *Sundy* or *Dammar Pooty* and are too light in colour and weight. They do not darken on exposure, and through the action of the sun the surface becomes full of small cracks. These inferior timbers can usually be told by the smooth surface left after the plane. The best *Ballow*, known as *Ballow Hetam*, is dark in colour, heavy, and after planing the surface becomes very dark, whilst the ordinary quality is lighter in appearance, of a light brown tinged with rose colour in patches. *Ballow Bunga*, which is similar to *Ballow* but lighter in weight and colour, has usually a figured grain of light and dark shades alternately. *Dammar Laut* is a large tree, close-grained and very strong. The timber, containing a large quantity of resin, is light brown in colour and feels sticky to the touch. It is used for local sailing vessels, but is not common at Singapore. *Rassak Merah* is a large tree, logs being obtained 50 ft. long, and up to 2 ft. square. This timber is likely to replace *Ballow* at Singapore, as large quantities are imported from the surrounding Dutch islands. There are a good many varieties of *Rassak*, varying in colour from light to dark reddish brown. It darkens in colour after being cut from the log or planed, and can be distinguished from *Ballow* by its peculiar shining surface. It feels smooth, and after exposure to rain and sun turns a dark red and can be used in small scantlings. There is a timber known as *Rassak Pooty* (*pooty* meaning white), but it is of no value, and should not be used in permanent buildings.

Darroo and Tembusoo.—These timbers, if of the best qualities, will resist white ants, but the market is full of young trees, of inferior timber and therefore risky to use. *Darroo* has a moderate-sized trunk compared to its height, with a fair amount of sapwood, and grows straight with a bushy top; the bark being similar to that of an elm-tree with the grooving or hollows more evenly divided. Good timber, which is found in logs about 12 in. square and up to 30 ft. in length, is of a light straw or

yellow colour, containing a large amount of moisture, with a resinous substance having a peculiar aromatic smell which is noticed at once when the timber is freshly cut or planed. It is close-grained and easy to work, with great strength and stiffness, but must be used under cover, as dampness causes it to decay, and exposure to the sun badly cracks it. It can be used in small scantlings, and will stand heat without warping. It has a peculiar silver grain, having the appearance of the wood being in small squares. The smaller logs, 6 in. square and under, are from young trees, and are of inferior qualities. *Tembusoo* is a fine-looking tree growing in pyramidal form, and having dark bark with deep vertical grooves. It is often called *Ballow Pooty* by the natives. It is only to be obtained in small scantlings, as usually the tree branches 10 ft. from the ground, or if in large scantlings only in short lengths, and is used in joiners' work. There are a number of *Tembusoo* trees growing about the officers' quarters in the enclosure of the Tanglin Barracks at Singapore.

Miraboo, Kumpas, Ballowboo, and Giam are all of a dark reddish colour, with fancy grain or markings. They are used chiefly for furniture and fittings; but are not plentiful, and should not be used in the structure of buildings on account of liability to white-ants and decay.

Seriah, Meranti, and Kledang are eaten by white-ants and other insects, are liable to decay from wet, and will not stand exposure to the sun. They are used in the form of planks for boarding and floors, also for fittings to door and window openings. *Seriah* is a tall tree, with a smooth bark of light red colour. There are a number of varieties, varying in colour from reddish grey to red and light brown. One called *Seriah-batu* has occasional white grain in the annual rings, and is the best timber of its kind. *Meranti*, which is similar to *Seriah*, but of a more reddish brown, is a magnificent tree, running up straight to a height of about 80 ft. before branching, and will grow to 100 ft. or 150 ft. in height, with a diameter of 3 ft. to 5 ft. *Kledang* is of a yellowish brown colour, darkening on exposure; it usually has a grain of dark and light bands, and leaves the plane with a smooth surface, which looks very fine when French-polished.

Lampong, Bintangore, and Mangrove are readily eaten by white-ants and other insects. *Lampong* is soft and light in colour and weight, of no value, and used by the Malays for floats and boats. *Bintangore*, which is of a coarse grain and light red colour, is used only as round poles for shipping spars, rafters, and purlins to roofs of ordinary houses, and also for the framing of all temporary buildings and sheds. The market sizes are from 1 in. to 10 in. diameter, the darker in colour the better and harder the timber. *Mangrove*, which grows on mud banks covered by salt water, and can be had up to 30 ft. in length, and 6 in. to 10 in. in diameter, is always used for piling to foundations, and for firewood in Singapore. The timber is dark red in colour.

Garling is rarely met with, and is used by the Chinese for their planes and other tools. It is of a green colour with dark bands, and is very hard and lasting.

Teak from Siam is used in Singapore for the better qualities of furniture, as it is light in weight and resists white-ants and other insects which destroy timber in the tropics. It also has a fancy pattern grain.

General Remarks.--The vernacular names have been given to these timbers, as a good many of the trees have no scientific ones. The scientific names can only be decided by the flowers, and many of these tropical trees only flower at intervals not at present known, and at a certain age. There is also a great difficulty in obtaining from the native hewers the flowers of the trees which they cut down. It is also not known for certain how to tell the age of the age of the hardwood trees, as until recently no records or observations were made. Three or four of the so-called annual rings might be added each year, while in some years no increase would take place. Observations have been made during the last eight or 10 years, but a period of at least 30 years must take place before any judgment can be formed as to the ages of these trees. It is probable that some of the huge hardwood trunks are at least 1000 years old. Generally speaking, the weight and darkness in colour of any tropical timber is a fair sign of its good quality. A good timber is always heavy, and where there are varieties of the same timber, the heaviest is the best. A number of the large-sized logs, about 24 in. square and upwards, are badly shaken at the centre, or have holes and vacancies with no decay. This has been caused either by discharge of lightning, or by these tall trees continually waving about with the wind. On the larger hardwood trees very little sapwood is found, and in many cases none at all.

In professional note-books references are found to "*Johore teak*." This is intended for *Ballow*, not *teak*, which comes from Siam, and is different both in appearance and weight.

The oak grows in Singapore, but the timber is of no value, being all open-grained, with the trunk running up straight, and nothing like the English oak tree in form.

There are other hardwood trees of the Malay Peninsula, one especially being so hard as to turn the edge of any axe, while others have poisonous sap which makes it dangerous work hewing them. As a matter of fact, the natives refuse even to climb any such trees.

At Singapore on the W. D. property, the following timbers may be found: At Tanglin, *Tampenis* in the structure of the officers' bungalows; at the new barracks on Blakan Mati and Pulo Brani Islands, *Ballow Hetam* in the door and window frames; *Giam* in the majority of the cupboards and other fittings; *Garling* in the barrel stand in the canteen at Pulo Brani; *Red Russak* in the joists, beams and roofing laths; *Red Russak* or *Ballow* in the

frames of the wood partitions; *Meranti* in the flooring and boarding of partitions; and good *Syriah* in doors, window shutters balusters, and handrails.

Timbers in General Use, Singapore, Straits Settlements.

Native Name.	Scientific Name.	Local Cost in Log per Ton of 50 f. c.	Weight per Cube Foot in Pounds.	Value of Constant "a."	Value of Constant "c."	Value of "S."
Seriah ..	<i>Shorea</i> sp ..	dols. 5	59	.0102	470	282
Meranti ..	<i>Hopea</i> Meranti ..	5	40	.0102	470	282
" Merah ..	<i>Shorea</i> sp furfuracea ..	7	45	.0102	470	282
Poonah ..	" ..	5	43			
Samarang ..	" ..	12	55½			
Rassak Pooty ..	" ..	12½	56½			
" Merah ..	<i>Vatica</i> Russak ..	13½	62	.0071	900	540
Belian ..	<i>Sideroxylon</i> Zwageri ..	50	57	.0066	817	490
Renas ..	<i>Gluta</i> Rengas ..	12½	45½			
Teak ..	<i>Tectona</i> grandis ..	60	47	.0076	821	717
Ballow Hetam ..	" ..	20	65	.0067	905	543
Ballow ..	" ..	18½	60	.0057	905	543
" Bunga ..	" ..	17	60	.0071	864	518
Tembusoo ..	<i>Fagraea</i> peregrina ..	17	50			
Dauumar Laut ..	<i>Canarium</i> Species ..	8½	63	.0068	1138	677
Darroo ..	<i>Sideroxylon</i> Malaccense ..	12½	57	.0054	1163	679
Krangl ..	<i>Dialium</i> Indicum ..	20	60	.0060	1012	607
Kledang ..	<i>Artocarpus</i> Species ..	10	46	.0076	893	537
Miraboo ..	<i>Azolla</i> Palembangica ..	17	54	.0077	1016	610
Tampenis ..	<i>Sloetia</i> sideroxylon ..	20	62	.0071	1282	770
Kledang Pooty ..	" ..	17	45			
Garling ..	" ..	25	50			
Blintangore ..	<i>Calophyllum</i> inophyllum ..	Sold by num-ber of pieces	36	.0082	609	366
Mangrove ..	<i>Rhizophora</i> Species ..		64	.0070	900	540
Backow ..	" ..		40			
Giam ..	" ..	20	67			
Lampong ..	<i>Hedyocarpus</i> cauliflora ..	20	28	.0147	384	230
Ballowboo ..	" ..	20	56			

NOTES.

One dollar value 2s. 2d.

Constant "a" used in formula (Tredgold) $W = \frac{R D^3}{a^2 L}$

showing the greatest weight in pounds that can be put upon a beam, loaded in centre and supported at ends, without causing a deflection exceeding $\frac{1}{480}$ th part of its length.

Constant "c" used in formula (Tredgold) $W = \frac{B D^3}{c L}$

showing the breaking weight in pounds for beam as above.

Value of S. is the value in pounds of S. used in formula (Barlow and Tarn) $S = \frac{3}{2} W_B \frac{L}{D^2}$ the transverse strength of

timber 1 inch square 1 feet long for beam as above.

W = pounds weight; B = breadth in inches; D = depth in inches; and L = length in feet.

Samples of the majority of these timbers are in the district surveyor's office, Singapore.

Scales of Timber Royalty charged by the Colony for Cutting Down Trees in the Forests at Malacca, Straits Settlements.

A.—First Class.

Name of Tree.	1 Ft. in Diameter.	1½ Ft. in Diameter.	2 Ft. in Diameter.	2½ Ft. in Diameter.	3 Ft. in Diameter.	REMARKS.
	dol.	dol.	dol.	dol.	dol.	
Ballow ..	2	4	6	8	10	These figures represent the value of the timber Duty at 25 per cent. (except where it is otherwise provided by the instructions) will be charged on these values. No timber of this class may be cut under 12 inch in diameter.
Bellian ..	2	4	6	8	12	
Chengal ..	2	4	6	8	10	
Dammer Laut ..	2	4	6	8	10	
Fasal Lings ..	2	4	6	8	10	
Giam ..	2	4	6	8	10	
Kayu Arang ..	2	4	6	8	12	
Kulim ..	2	4	6	8	10	
Kahuk Baring ..	2	4	6	8	10	
Meruboo ..	2	4	6	8	10	
Penaga ..	2	4	6	8	10	
Tembusoo ..	2	4	6	8	10	
Tampenis ..	2	6	8	12	15	
Sepan ..	2	4	6	8	10	
Seriah Batu ..	2	4	6	8	10	

* Ebony should not be cut except by the Forest Department officers.

B.—Class 2.

Name of tree.	1 Ft. in Diameter.	1½ Ft. in Diameter.	2 Ft. in Diameter.	2½ Ft. in Diameter.	3 Ft. in Diameter.	2 in. in Diameter.	3 in. in Diameter.	4 in. in Diameter.	5 in. in Diameter.	6 in. in Diameter.	7 in. in Diameter.	8 in. in Diameter.	10 in. in Diameter.	REMARKS.
	dol.	dol.	dol.	dol.	dol.	c.	c.	c.	c.	c.	c.	c.	c.	
Babi Kirus ..	1	2	3	4	5	1	2	4	7	10	15	20	25	Duty will be charged upon these values.
Berombong ..	1	2	3	4	5									
Bintangore ..	1	2	3	4	5									
Daroo ..	1	2	3	4	5									
Kelat ..	1	2	3	4	5									
Kladang ..	1	2	3	4	5									
Korangi ..	1	2	3	4	5									
Medang ..	1	2	3	4	5									
Meranti ..	1	2	3	4	5									
Pagar Anak ..	1	2	3	4	5									
Petaling ..	1	2	3	4	5									
Renas ..	1	2	3	4	5									
Rasak ..	1½	2	4	6	8									
Seriah Sabut ..	1	2	3	4	5									
Tampi-Tampi ..	1	2	3	4	5									

Class C.

All woods	other	c.	dol.	dol.	dol.	dol.	c.	c.	c.	c.	c.	c.	c.	c.
		75	1	1 50	2	3	½	1	2	4	8	7	10	15

Engineering.

Pitch Pine.

People often ask, says the *Révue des Eaux et Forêts*, what the Pitch pine is, and the question has just been answered by M. Pierre Boissaye, Garde Général, who is on a forest tour round the world and writes from Quebec, and tell us that the real pitch pine wood comes from the *Pinus australis*, which is a tall handsome tree found in the Southern United States. It is remarkable for its very cylindrical tall bole, so that it is capable of giving long pieces, especially masts and spars. The cones are very large and the seeds are edible. The Americans sometimes call the tree 'Broom pine' from its broomlike fascicles of pendant needles; but commercially the timber is known as 'pitch pine,' 'red pine' or 'yellow pine,' according as it consists of old resinous wood, ordinary middle aged wood without sapwood, or sapwood only. As a matter of fact, however, much of the timber sold under these names belongs to other species which are passed off as *Pinus australis*.

It has not been possible to introduce it successfully into France, as it is a tree of a much hotter climate, and the *Révue* does not recommend further attempts to grow it, as it considers that old Pinaster in the Landes if allowed to grow to the same exploitable age as pitch pine, that is 120 to 150 years, would give just as good products.

In India, an attempt was made some years ago to grow the *Pinus australis*, and we remember taking great pains, but unsuccessfully, to grow it in Dehra Dun. It might do better in a more equable climate, as about Bombay.

We hope that, in the course of his travels, M. Boissaye will visit India. He may be assured like many of our French comrades of a hearty reception.

Tour of the Coopers Hill students in France.

We read in the *Révue des Eaux et Forêts* that this year the Coopers Hill Forest students have, for the sixth time, visited the beautiful oak forests of Réno-Valdieu, Bellême and Perche near Mortagne. There were six students under the Assistant Professor of Sylviculture, Mr. W. R. Fisher, but they were also accompanied by Mr. H. C. Hill, lately Acting Inspector-General of Forests in India, and Mr. Baylis, the Forest officer in charge of the Forest of Dean in Herefordshire, with three of his Rangers. They were also accompanied by the Conservator of Rouen and the Inspector of Louviers, and the whole party was guided by the Conservator of the Circle, M. Charlemagne and the Inspector, M. LeLecreur.

At this time, when French newspapers are full of untrue statements about and spiteful attacks upon England and English diplomacy, it is pleasant to find that the French Forest officers have been able to keep themselves above the petty meannesses of Parisian journalism and maintain the old friendship, which has so long existed between the Forest officers of France and of India, and which we sincerely hope will never be allowed to fail.

A Forest Department Blazer.

The following is an abstract of the replies which have been received in answer to a post-card circular on the subject of a Forest Department blazer, sent by Mr. Elliott to all officers of the Imperial Forest Service under the Government of India, except those in Burma.

	No. of replies.
Fully approve of proposed colours ...	19
Approve, but suggest modifications ...	17
Wish for colours, but disapprove of those proposed ...	4
Are indifferent on the subject ...	5
Disapprove of colours ...	3
Total ...	49

From some 40 officers no replies have as yet been received.

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A Few Days Holiday.

What is more delightful than a few days holiday after being stuffed up in an office for many weeks ; the pleasure of anticipation, wondering what one had better do to make the most of it ; the arrangements to be made and plans for getting to the best place in the shortest possible time ; the loading of the cartridges and cleaning of the gun long hidden away in the corner ; or the examination of the tackle box and fly-book, and the doubt whether it would not be wise to shy all the old tackle away and buy some more, sad memories of that monster fish, the largest one you had ever hooked, that disappeared with your best spoon and the greater part of an old and rotten trace, pointing strongly to the advisability of the latter proceeding.

Some time since it was my good fortune to obtain such a holiday, and I arranged with a hospitable brother-officer to spend it with him in the pursuit of such game as the native shikari had not succeeded in exterminating (which it may be noted was found to be but little) and in roaming about some of his picturesque and interesting deodar, oak, and pine forests, where points of interest to the Forester's eye strike one at every corner. These forests are the property of Independent Native States, and wherever conditions have rendered the material saleable, they have in most cases been most unmercifully "slated," all marketable timber having been cut out without any thought of what might happen in the future. I had ample opportunity of observing the effects of this short-sighted policy during my ride of 35 miles to join my friend's camp ; and the bare hillsides with but scattered and deformed specimens of deodar, oak, or pine, remaining of the fine forests which the vicinity of a large hill station and the high prices there obtaining have caused to disappear, show how complete the destruction has been. Of late years, a professional Forest officer has been deputed by Government to inspect the forests of the Native States, to advise the Chiefs as to the management of their

forests, and to bring to notice cases where they are wantonly destroying them either by lopping, overgrazing or overfelling. Much good has already resulted from this step. First, the States have been induced to demarcate all their more valuable forests, and then, by setting them aside as permanent timber-producing estates, rescue them from the gradual encroachment of cultivation, particularly that for the potato which in these hills is pursued sometimes but for a year or two to the great destruction of forest growth. Boundary registers and a rough record of rights are kept up for the demarcated areas. Then gradually simple Working Plans are being drawn up and the Chiefs induced to abide by their conditions, the principal of which is not to fell more than a fixed number of trees per annum. The lopping of deodar and to some extent of the blue pine has been put a stop to, within demarcated forests. The prevention of lopping in these forests is an extremely difficult problem. The people have been accustomed for ages to lop unchecked, and this destructive custom has become almost a necessity to them. The grass crop in these hills is but scanty, and the leaves of the oak (*Quercus dilatata*) are in great request as fodder. Deodar also and the pines (*Pinus longifolia* and *Pinus excelsa*) are in all unprotected areas heavily lopped up to a few feet of the top, but a branch being left at the crown. The branches and spines are used first as bedding for cattle, and afterwards, when well saturated with cattle refuse, as manure, being laid over the ploughed fields and worked well into the soil. I noticed two very interesting results from this heavy lopping; first, the destructive effects of parasites in general and more particularly of a species of *Loranthus* (probably *L. vestitus*) on the oak in heavily lopped areas. In one forest over a large area where lopping has been constant, nearly every tree had been thus attacked. Many of the trees have been already killed outright by the parasite which appears to suck the life out of the trees, mainly through the wounds caused by lopping, and to fairly smother it. An examination of the trees showed that wherever a branch had been lopped off, the *Loranthus* had obtained a fresh holding place on the tree over which it gradually spreads, until there is more *Loranthus* than oak. It can be but a question of a few years more or less and the oaks in this forest will be exterminated.

The second point which caught my attention was the effect on the crop of the lopping of certain species, whilst others were protected. The crop in the forest which came under my observation consists mainly of oak (*Q. dilatata*) and blue pine (*P. excelsa*) with a small mixture of deodar forming perhaps not more than 5 per cent. of the crop. Some 10 years ago the Chief of the State, of which this forest is the property, was induced to put a stop to the lopping of deodar, the lopping of the oak and blue pine continuing as before. The result of this has been that a very nearly pure young deodar forest is rapidly gaining possession of the ground, and in process of time there can be no doubt that, should present

conditions continue, this area will hold a nearly pure deodar forest. And judging from the results here obtained, it may be concluded that such loppings, in Forests in which it is desired to increase the proportion of deodar, might have the desired effect as successfully and rapidly as by ringing trees and undertaking expensive planting operations.

The country we were in is naturally the home of the kalege pheasant, and where cultivation affords them the necessary food, the chikore are to be heard chuckling in the early morning. Moreover, in certain favoured localities coveys of "*chir*," perhaps the best of the Himalayan pheasants from a sporting point of view, not to mention his great qualifications when placed, well cooked, upon the table, are to be found. In the higher portions of the oak forests a solitary "*koklas*" may yet be heard uttering his mournful cry or rather croak, giving one the impression that he must have a really bad sore throat. But pheasants in the neighbouring hill station are worth Re. 1 apiece, and chikore come in handy for a dinner party ; and one must go far a-field to find birds in any number. So our modest bag of 5 *chir* pheasants, and 3 chikore represented a lot of hard walking, not to say straight shooting, and the bottle of beer apiece at the close of the day was well earned. And so back to work again with a keener zest, and a pleasant sense of a much enjoyed holiday amongst the steep hills and the scattered forests of the Simla Hill States.

F. B. B.

Working Plans in the Southern Circle of Bombay.

(Concluded.)

THE NORTH KANARA WORKING PLAN.

The plan originally submitted for working the best forests of the Haliyal and Supa Taluka and Petta of the Kanara Collectorate was briefly as follows : —

The total area of the forests was divided into 24 equally productive parts as regards teak. Each of these parts was to be worked in turn once in 24 years on the selection system. Trees of 25 inches diameter and upwards only were to be felled, the rotation being fixed at 180 years.

The number of trees to be felled annually was calculated and this was divided into two parts as under :—

- (1) The annual increment of the whole area.
- (2) Half the extra increment accruing on the area which remained unexploited from the first year after the completion of the estimates till the year of exploitation.

The estimates were finished for the whole area in a few years, and so, in order to produce a series of age gradations for the second period, it was necessary to cut in the first year of the first period

and on the first area, 24 years' increment, or in other words the annual increment of the whole area = I . In the second year $I + \frac{1}{24}I$ would have to be cut, as the second area would have produced one year's extra increment. In the third year $I + \frac{2}{24}I$ would be cut, and so on, until, in the twenty-fourth year, nearly $2I$ would be cut. In the twenty-fifth and succeeding years only I would be cut, as each area would contain in turn the same number of trees of 25 in. diameter and over as it did when estimated, provided the estimates and calculations had been correctly made.

There were two principal objections to working in this way, and they were—

(1) Owing to the difficulty of making accurate estimations and calculations in such irregularly grown forests, it was dangerous to get rid of all surplus stock at once.

(2) By cutting all the extra accruing increment in this way, the annual outturn would increase by $\frac{1}{24}$ each year on the outturn of the first year, until in the twenty-fifth year it would fall suddenly again to its original amount.

Accordingly, it was laid down, in the original plan, that only half the extra increment was to be removed in the first period of 24 years, and that the remaining half was to be removed in the second period. Therefore the fellings during the first two periods were settled as follows:—

In the 1st year I to be cut		In the 25th year I to be cut	
2nd	$I + \frac{1}{24}I$	26th	$I + \frac{1}{24}I$
3rd	$I + \frac{2}{24}I$	27th	$I + \frac{2}{24}I$
.....
24th	$I \times \frac{23}{24}$	48th	$I \times \frac{23}{24}$

(and in the 49th year and after, I to be cut.)

By this arrangement firstly the danger of over-cutting was avoided in the first period; secondly, the sudden fall in the 25th year was reduced by one half. The amount of selection that could be made was also much increased.

In the interval between the estimates and the application of the Plan irregular fellings were to be, and were made over large areas, and, as no lists of (the number of trees felled were kept compartment by compartment, the compartment being the unit for estimation), it was not possible to know how many trees over 25 in. remained in each of the different compartments. Accordingly, it was originally laid down that, when there were calculated to be, say, n trees of 25 ft. and over on an annual cutting area and the number of these n trees to be cut was, say, c , and therefore the number left uncut was $n - c$, the work should be commenced by reserving the calculated number $n - c$ of the best trees over 25 in. in diameter; after which the remaining trees over 25 in. were to be felled. This

would have compensated for the irregular cuttings that had been made during 8 years beginning with the commencement of the estimation. It would also prevent over-cutting on areas which had been overestimated.

But this method of reserving a number of trees over 25 in. calculated to remain after exploitation was objected to and discarded as, although it prevented overcutting and was the only possible way of really carrying out the idea of the plan after the irregular fellings had been made, it had the disadvantage of not ensuring large outturns during the first few years of the first period; the reason for this disadvantage was that most of the trees had been removed from the areas which it was thought desirable to commence the cuttings on, not for any scientific reason, but because these areas happened to be the most cheaply workable. So the plan was altered, and these selections were avoided.

The more remote parts of the area, which had been previously but little worked and which most required working, were purposely left to the last; the easily worked parts which had been already heavily cut over being chosen for the first years of the period simply for financial reasons.

The following modifications were afterwards made in the plan :—

(1) It was decided, without any reason being given, that all the extra increments should be removed in the first period, instead of reserving half for the second period. The disadvantages of this have been shown above.

(2) It was decided that, although in no case should the fellings be made, except in the areas laid down for each year in the plan, still, where more than the number of trees laid down to be felled were found on the area, all those above 25 in. in diameter should be felled.

It was imagined that, while in the first case overcutting was provided against by the area check, in the second case undercutting would be avoided. But such is not the case.

The plan lays down the area to be exploited once for all. When the estimated number of trees is not obtainable, it proves that the number of trees has been overestimated, or that trees have already been felled on the area since the estimation was made, or both. If the number has been overestimated, the fellings should obviously be further restricted than by merely forbidding the working, against the rules of the plan, of additional area. Where the calculations show that a certain number of trees over 25 in. should remain after exploitation, it is evidently overcutting to remove the $n-c$ trees. Similarly, where the actual number of trees over 25 in. is greater than the calculated c (as should always be the case), there is nothing to justify the cutting of all trees over 25 in. For, according to the calculations $n-c$ should be left. The original plan was so made that blind haphazard fellings of all trees above

25 in. were not possible. Selections were to be made, and the best of the larger trees reserved. As explained above, not only has this been prevented by the modifications introduced but whereas only a certain number of the trees over 25 inches were calculated to be available for felling, this number has been increased contrary to the provisions of the plan and without reason.

In many cases, according to the calculations, owing to the large proportion of trees over 25 inches, supposing they were all to be cut, it would take 50 years, if not more, to produce the required number of large trees to replace those felled. Whether the smaller trees, *i. e.*, those of the antepenultimate class and earlier classes would ever grow to 25 inches in sufficient numbers, even then, is doubtful, owing to the bad quality of many of the trees.

It is accordingly evident that these changes upset the whole plan, by reducing the supply of large trees during the second period, and by making it impossible to make those selections which would have done much to compensate for the shortcomings of the original plan. As it now stands, the plan is simply an arrangement for felling all the fastest growing trees in the next 24 years, thereby swelling the revenue of that period at the expense of the future.

A thorough examination of the Kanara teak trees shows that they differ enormously on different soils, and side by side, in their rate of diameter growth. This rate of growth in diameter is the basis of the calculations used in the plan.

The teak tree is a light-demander inasmuch as, to grow fairly well, it requires plenty of light and room; a shade-bearer, inasmuch as it is only completely suppressed by the other trees after a struggle of perhaps hundreds of years. We find trees with a growth half an inch in radius in one year in abnormal cases of quick growth, while the growth is frequently so very slow that the rings cannot be counted at all, even with the aid of a powerful lens. Standing side by side will be found two teak trees, each over 100 in height, one 25 in. in diameter and 200 years old, the other perhaps older but only 12 inches to 16 inches in diameter. A very important point to notice is that over the greater part of the area the majority of the trees over 25 inches in diameter are growing well, while most of those below 25 inches, excepting the very small trees, are more or less suppressed, and are growing but slowly.

Accordingly, to cut a large number of trees over 25 inches is to lower the rate of growth. It is therefore a mistake to fell the largest trees, the mature trees being, as a rule, not the largest, but the half grown.

On over 1-5th of the whole area, *i. e.*, east of the Kalinadi, the growth is very inferior, chiefly owing to forest fires, a poor, badly drained soil, and a want of cover, and, last but not least, the cutting out of the best trees in these conveniently exploited areas. The rotation of 180 years is undoubtedly too long for these parts, and the trees might with advantage be cut before they reach 25 inches, a size to which sound trees in these parts now seldom

grow. Here we have a mistake made in leaving all the trees to reach 25 inches, whereas the majority cannot well last till then ; the converse mistake, in addition to this one, is made on the rest of the area, where all trees on reaching a certain size are to be cut whether mature or not. Fellings made in this way have little right to be called Selection Fellings.

A noticeable feature in the utilization of data for preparing the plan is the neglect of height growth. Although many data concerning this were collected, no use was made of them and the importance of the height growth as a general indication of the relative proportionate lengths of rotation suitable in different places, is not recognised. A glance at the short growth in the eastern parts shows that it cannot bear such long rotation as the rest of the area.

For several years the amount of large timber exploited has been very large. In 1892-93, and 1894, large quantities remained unsold, the market being glutted. This large supply of large timber makes it hard to get a sale for timber of 15 inches to 20 inches in diameter. It is now proposed to increase the out-put, the average increase during 24 years, being estimated at 70,000 to 80,000 cubic feet per annum ; but this is on the supposition that only the amount originally laid down in the plan is to be cut. As all the trees to be felled are 25 inches and over, the glut of large timber will increase, and the demand for smaller material will be very poor.

The two principal results of this are :—firstly, that, whereas it is already impossible to make financially profitable thinnings of small, slow growing, partly suppressed trees of 8 inches to 14 inches in diameter, it will be now impossible to get the larger suppressed trees of 15 inches to 20 inches profitably removed on the required scale : they must be left to die ; secondly, the area, for which the plan has been made, includes the greater part of the best teak forests of North Kanara, and in addition to this area there is a larger extent of second rate and third rate teak forest extending into the Belgaum and Dharwar Districts ; these forests require to be taken in hand and worked, were it only to preserve the shade-giving jungle woods which, on inferior localities, get ousted by the teak, leaving dry, deteriorating, pure teak forests. But there is another reason for working these forests, and that is on account of the large amount of mature teak of moderate dimensions which would fetch a fair price, were only the sales of the larger timber restricted. The larger timber, however, being naturally preferred to the smaller, although it is not necessary in such large quantities to supply the known demand, has been alone exploited to such an extent that there is no demand for the rest ; consequently the inferior forests are neglected. The effect of further increasing the outturn of large timber is of course to diminish the likelihood of there being any market for the mature trees of the inferior forests.

To sum up the objections to the plan briefly, they are the following :—

1. The area for which the plan has been made has*been irregularly exploited since the estimates were made, and hence the proper fellings have been interfered with. This difficulty has not been met by any modification of the number of trees estimated.

2. The amount originally calculated to be cut has been increased contrary to the provisions of the original plan, and for reasons that will not bear examination, while the fellings to be made in the 25th year are only half of the outturn in the 24th year.

3. The plan provides for the exploitation of immature timber, while it does not provide for the due removal of mature timber and it renders the latter, together with desirable thinnings, financially unprofitable.

4. The forest is to be so worked that it will be next to impossible to exploit neighbouring areas of large extent which urgently require to be worked.

The Bombay Government have approved of the proposal that in the event of the Conservator of Forests finding that the supplies in depôts get too far ahead of the demand, it shall be left to his discretion to curtail girdlings and cuttings at any time. When once a plan has been made, it is advisable to stick to it for a definite period. If it be interfered with, the plan cannot be afterwards corrected properly. In the present case there is every reason to fear that if girdlings were restricted, in the absence of any proper system of selections, the worst trees would be left and the best girdled. Were the outturn of large timber so regulated in the plan that there would never be a glut, and were it laid down that the Divisional Forest Officer should be responsible for the reservation of all the best trees of, say, above 15in. before the exploitation of any area, no such necessity could arise for irregular interference, at unstated times, with the proper carrying out of the plan; and, in addition to the preservation of the best timber being effected, it would be then possible not only to get rid of much inferior growth on the area covered by the plan, much to the benefit of the forest, but to exploit the, at present, unmarketable mature trees of the inferior forests, the proper management of which is more urgently called for than that of these superior forests.

C. HODGSON.

System of Measuring and Selling Timber in Siam.

A short description of this may be of interest to readers of the *Indian Forester*. The Siamese long measure is as follows :—

4 Kabiet	...	1 Niu ($\frac{9}{8}$ English inches)
5 Niu	...	1 Kam (of semi-girth)—($8\frac{1}{2}$ in. girth)
12 „	...	1 Köp.
2 Köp	...	1 Sawk (20 English inches)
4 Sawk	...	1 Wa (80 „ „)

The length of a log is always stated in Wa and the girth in Kam, but as the Kam represents only the semi-girth, a log of 6 Kam will girth actually 60 Niu or 50 inches.

The system of buying or selling timber is ingenuous; cubic measurement is unknown, so a standard of sale has been evolved. From what period this standard dates I have not been able to discover, but it is clearly not of recent origin; it is called the "*Pikat Nua*" or Northern tariff, and nearly all timber in the round is sold by the "*Pikat Table*." This table is given at the end of this note, and it will be seen that a value in Ticals (the silver coin of the country, equal to about 17 or 18 annas) has been given to logs of each dimension. When the table was compiled it is probable that these rates represented the actual value of teak timber, but this is no longer the case, for the Bangkok market rate of teak is now from $6\frac{1}{2}$ to 7 *Pikat*, that is to say, a log will now fetch $6\frac{1}{2}$ to 7 times the number of Ticals shown in the *Pikat* table. When a raft of timber is to be sold, it is the number of *Pikat* that is mutually arranged, instead of the rate per ton, as in Burma.

Duty is levied more or less according to the *Pikat* table, but the amount of duty leviable is stated for each dimension, and it will be seen that this does not follow the *Pikat* table exactly. It is presumable that the duty was fixed in comparatively recent times and represented the comparative value of the timber at that time, but neither the *Pikat* nor the Duty Table now represent the comparative value of the logs, as may be seen by converting a few of the *Pikat* measurements into cubical measure.

The system of measuring timber for duty is that adopted throughout the country, and is briefly as follows:—Two men measure the logs and a third enters the measurements on a slate from which he makes up the bill later. One of the measurers carries the "*Mai-wa*," or measuring stick, which is a wooden rod 2 in. square by 80 in. long and shod at either end with a metal boot. On one face the *Mai-wa* is divided into 4 *Sawks*, and on the other into $19\frac{1}{5}$ *Kam*. The length of the log is measured by stepping the stick along the log. The second man is armed with a strip of rattan about $\frac{1}{2}$ in. wide, nicely smoothed, which may be of any length but which is usually about 10 ft. long and attached at one end by a 6 inch snood to a cigar-shaped wooden float about 2 in. in diameter and 8 in. or 10 in. long. To measure the girth the float is pushed some distance under water and then shot under the log—up it bobs on the far side, where it is dexterously caught by the *Wa-stick* and the rattan is tightly stretched round the log; the point of contact being held firmly in one hand, the rattan is withdrawn, *doubled in half* and measured on the *Wa-stick*. The length has been measured at the same time and reading off the semi-girth the man with the *Wa-stick* calls out "*7 Wa, 6 Kam*" or whatever the measurements may be. With a little practice the length can be correctly estimated, 4 times out of 5, and occasionally there are

whole sections of rafts containing logs of the same (Wa) length, only one of which need be measured.

There are several customs which I should imagine have originated in the "good-will" of the Revenue Collectors, as they are all in the interests of the owner. One of these consists in raising the half limit to three quarters; thus a log is not counted as 6 Wa unless it is at least $5\frac{3}{4}$ Wa. Similarly, with the girth, only more so. To count as 6 Kam a log must be at least $5\frac{1}{4}$ Kam, any log between $4\frac{4}{5}$ and $5\frac{4}{5}$ counting as 5; this is on the semi-girth it must be remembered, so that in reality a log measuring between 41 in. and 49 in. is counted as 42.5 in (omitting fractions).

Again a rattan admits of a good deal of stretching and it is allowable to pull it as tight as possible on the log, but when the same is transferred to the Mai-wa it is customary to put one finger in the loop of the doubled rattan and just pull it taut, the difference between the stretched and slack rattan with the space on the latter taken up by the head round the finger is a by no means negligible quantity. When it is added that the Wa and Kam are not fixed by Statute but vary in length, according to locality, and that the officials who measure timber, paying from 3 to 4 lakhs of revenue a year, draw from Rs. 13 to Rs. 17 a year and are subject to no check whatever, it must be admitted that the trade is not unduly hampered!

For sawn timber, the unit of measure is the "Yok" which is a plank 1 Sawk (20 in.) wide by 16 Wa (106 ft. 8 in.) long. The rate per "yok" varies with the thickness of the timber, thus planks—

1 Niu thick sell for Tcs. 10 per Yok

2	"	"	"	18	"
3	"	"	"	24	"
4	"	"	"	34	"

but of late years "the business" in teak planks having passed to the hands of European firms, with saw-mills, the "Yok" is dying out as a unit of measurement.

Pikat Table with Duty Rates.

Grain in Kam.	Length in Wa.													
	3		4		5		6		7		8		9	
	Ticals	Duty	Tics	Duty	Tics	Duty	Tics	Duty	Tics	Duty	Tics	Duty	Tics	Duty
5	0'30	0'40	1	0'50	1'50	0'75	2	1'00	4	1'25	6	1'50	8	2'50
6	0	0'50	2	0'75	3	1'00	4	1'25	6	1'50	8	2'50	10	3'50
7	2	1'00	3	1'40	4	2'00	6	2'50	8	3'15	10	4'40	13	5'15
8	3	1'50	4	2'00	6	2'50	8	3'55	12	4'40	14	5'15	16	5'50
9	4	2'00	6	2'55	8	3'55	10	4'40	16	5'50	20	6'75	22	7'55
10	5	2'55	8	3'50	10	4'40	12	5'55	20	6'75	24	7'55	26	8'75
11	6	3'50	10	4'00	12	4'75	16	6'40	24	7'55	28	9'50	32	10'15
12	7	4'00	12	4'75	16	6'40	20	8'00	28	9'50	32	10'15	36	11'25
13	8	5'15	14	5'55	20	7'55	25	8'75	32	10'15	36	12'00	44	13'50
14	10	5'55	16	7'05	24	8'75	30	10'40	36	12'00	42	13'00	50	16'00
15	12	6'75	20	8'75	28	10'40	34	12'00	40	13'00	48	16'00	60	19'55

LIFE HISTORY OF MELASOMA POPULI IN THE N.-W. HIMALAYAS 429

The Pikat table does not consider logs of smaller dimensions than 3 Wa by 5 Kam, but the duty table goes down to very small logs which it is useless to show here. These rates are for teak timber which is almost the only wood in which any trade is done but there is a duty table for woods other than teak which is generally about half that for teak.

H. S.

CHINAT, SIAM, }
8th October 1896. }

Life History of *Melasoma populi* in the North-West Himalayas.

The larvæ of this beetle are commonly found feeding on the leaves of *Salix elegans* at elevations varying from 6,000 to 9,000 ft. in the Jaunsar Forest Division in sufficiently large quantities to quite defoliate the small trees, on the leaves of which they feed. They are also occasionally found on the leaves of *Salix daphnoides* and *Populus ciliata* at slightly lower elevations.

The eggs are laid in clusters of 40 or 50 on the under surfaces of leaves, and the young larvæ apparently hatch out about 4 days after the eggs are laid.

The larva changes its skin twice before it becomes comatose preparatory to turning into a pupa.

The first change takes place 4 days after the larvæ are hatched. After another 7 days the larvæ again change their skins, and at the end of another nine days they become comatose. They usually remain in this state stationary, and without taking food for about 2 days and then pupate. The insect remains in its pupal state for 8 days, after which time the fully developed beetle emerges.

The larvæ are attacked by two parasitic flies, one of which is believed to be a species of *Tachina*.

The parasites in both cases develop with and live on the larvæ. In each case the larva of the parasite develops into a pupa at the same time as the larva of the beetle becomes comatose preparatory to turning itself into a pupa. The pupa case of the *Tachina* resembles in shape and colour a very minute German sausage, and one fly emerges from each beetle pupa. In the case of the other parasite, a number of pupæ (6 to 10) are developed in each pupa of the beetle. Pupæ of both parasites can be distinctly seen inside that of the beetle.

The following is a description of the fully developed larva. A full grown larva is 0.50 inch long and 0.23 inch wide at the

largest part. It has six thoracic legs. Two prolegs are developed, one on either side of the anus on the last abdominal segment. These are used as legs when the larva walks. The head and legs are jet black, the rest of the body being of a yellowish white colour. A pulsating movement is very distinctly visible down the centre of the upper surface of the body of the larva.

The first segment of the thoracic region has a black horse-shoe shaped mark on its dorsal surface. The two other segments of this region have 10 small black dots on them and two glands, one near either side of the body. Four of these dots are on the sides of the larva, two on either side; and two sets of three dots arranged in the form of an equilateral triangle with its apex towards the centre of the body are on the dorsal surface.

The next six segments (the first six of the abdominal region) have each two rather transversely lengthened black dots arranged equi-distantly from the centre of the body. On each of the abdominal segments also there are two glands, the whole forming with the glands on the thorax two longitudinal rows on either side of the insect. When the larva is disturbed, it protrudes from each gland a transparent globule of liquid, which smells very strongly of oil of almonds (prussic acid) and serves no doubt as a protection against birds. These globules are withdrawn after a few seconds and the insect does not seem to have the power of protruding them again for some little while. The presence of the larvæ can generally be detected, if they exist in fair numbers, by the smell emitted by them, long before they are seen on the tree.

The abdominal end of the pupa is enclosed in the skin which is last thrown off. The pupa has the same markings and colouring as the full grown larva, but the yellowish parts become much darker at the end of the first or second day. The antennæ, wing cases and legs are distinctly visible in the pupa, the first two pair of legs are above and the third pair below the wing cases.

The beetle is fairly constant in size and is $\frac{3}{8}$ inch long and $\frac{1}{4}$ inch wide. The head, thorax and abdomen are bluish black in colour, and shiny; while the wing cases are large, cover the abdomen completely, semi transparent, and vary in colour from light amber (when newly emerged) to light brown when fully developed. The beetles have been seen eating leaves, but do but little damage compared to their larva.

The following information and measurements are taken from my rough notes on some larvæ of *melasoma populi* kept in confinement and reared from eggs found on the lower sides of the leaves of *populus ciliata* and *salix daphnoides* in the second week in May 1894.

The eggs are 0.08 inch long and 0.03 inch wide at the broadest part. They are light yellow in the centre and semi-transparent, being darker in the centre than at either end. The larvæ, when first hatched, have not got sufficiently strong

mandibles to bite through a leaf and they consequently only eat off a part of either the upper or lower surface.

The larvæ were carried about with me on tour and were fed on such species of willow as were found at elevations of from 3,000 to 8,000 ft. and did not seem to suffer from the considerable changes of temperature they were exposed to. They ate the leaves of all the different species of willow that I gave them.

The larvæ when hatched were 0.05 inches long on an average, and protruded globules of pungent colourless liquid just as the full grown ones did. They feed in clusters when very small. Immediately after the first change of skin, their average length was 0.23 inch. Just after the second change of skin they were on an average 0.40 long and 0.15 wide at the broadest part. The black horse-shoe shaped marking on the first thoracic segment appears just after the first change of skin. When full grown the larvæ were half an inch long.

C. GILBERT ROGERS.

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The first segment of the thoracic region has a black horse-shoe shaped mark on its dorsal surface. The two other segments of this region have 10 small black dots on them and two glands, one near either side of the body. Four of these dots are on the sides of the larva, two on either side; and two sets of three dots arranged in the form of an equilateral triangle with its apex towards the centre of the body are on the dorsal surface.

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C. GILBERT ROGERS.

The Germination of Teak Seed.

With reference to the letter signed Gokal Das in your September number, the following method has been tried in Ceylon. The seeds were spread on the ground on a mat about 4 inches thick and constantly watered in the sun, the heat quickly caused them to germinate and coolies had to be put on the 3rd day (as they sometimes germinate as fast as this) to pick out the germinating seeds.

These were then pricked out in nurseries, which are watered daily, morning and evening, and the first leaves appear above ground in a fortnight. A description is given in the March number (1895) of the *Ceylon Forester* of the method of planting teak. The method I have mentioned above should be only resorted to in fine weather, as, if the seeds are kept too moist and get no sun, they are apt to rot off.

JAFFNA, CEYLON; }
31st October, 1896. }

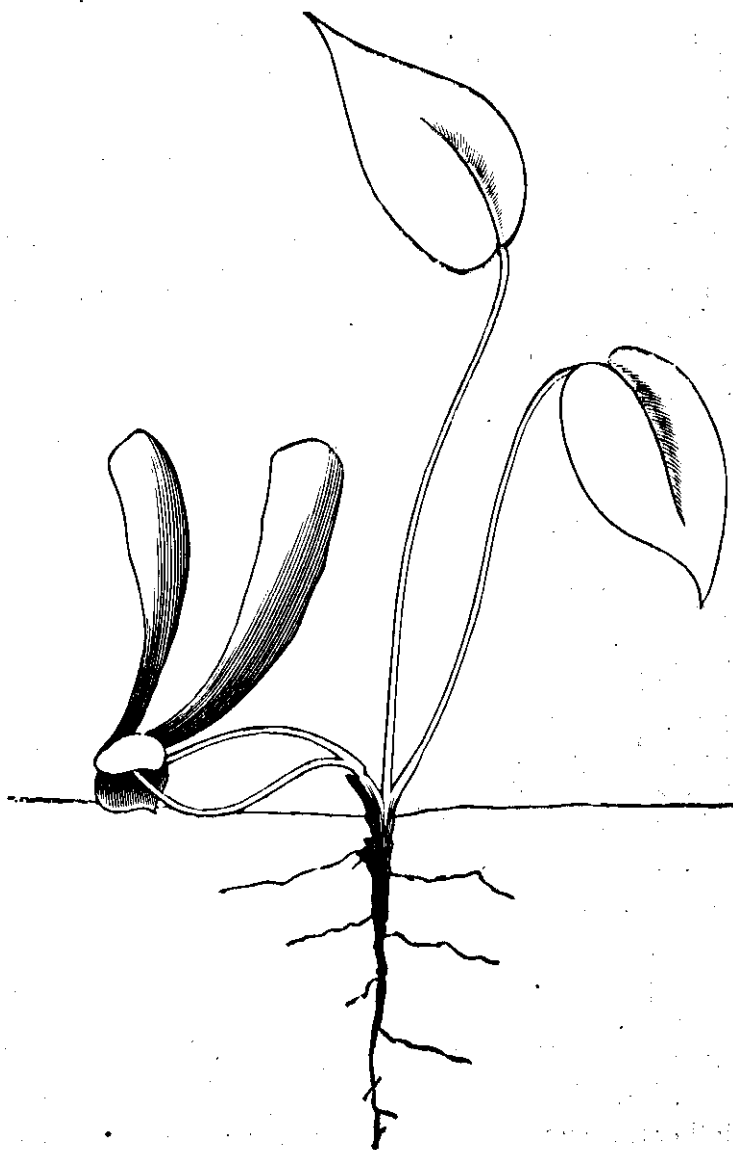
H. P. ARMITAGE.

The Germination of Sal.

I enclose a drawing of the mode of germination of sal. It appears to be much like that of the *Quercus Semecarpifolia*, as

shewn by Mr. Leete, I think, in the *Forester* some time back. I imagine that the system is specially adapted to the finding of a way through the thick coating of dry sál leaves to the soil beneath.

A. G. H.-H.



III.—OFFICIAL PAPERS & INTELLIGENCE

Note on Lac.

By M. RIDLEY, Esq., SUPERINTENDENT OF HORTICULTURAL
GARDENS, LUCKNOW, DATED 6TH JUNE 1896.

Regarding the statement commonly made, and as generally believed, that "if lac is not removed from trees it will in time destroy the trees," I have practically demonstrated and proved in the most conclusive way that the above theory is incorrect and entirely at variance with fact. When I first came here, 23 years ago, the matter then came under my notice, many large trees in the Wingfield Park, Residency Grounds, and the station avenues, were badly infested with lac, and the plan then in vogue was to sell the lac to contractors, who in collecting it denuded the trees to a most objectionable extent. This led me to think of some way or means of keeping the trees clear of the pest. A Forest officer informed me that this could be done by lopping off all the leading branches and afterwards stripping the branches and stems of all leaves and twigs, the object being to divest the trees of all infected parts and to remove all trace of the lac insect and so prevent its breaking out on and spreading over the trees so treated again.

I adopted this plan with one or two trees in the Wingfield Park, but found it ineffectual, as on the new branches and shoots which were developed, lac again appeared as bad as before. This plan proved an entire failure to protect or keep trees clear of lac.

I then decided to stop lac collecting on a few trees to test and prove the theory about its destroying the trees. The result of this experiment was that after a time the lac all disappeared and the trees in a short period recovered from the effects of the lac and became perfectly clear and healthy again. This is absolute fact, and I can show numerous large *peepul* and *pahar* trees, which at one time were so infected with lac as to be most unsightly objects, now entirely free from the pest, and the trees healthy and vigorous.

On the representation I made to Mr. Boys, when Deputy Commissioner here, he passed an order prohibiting the sale of lac from trees in the station, and since then I believe no lac has been collected from trees on avenues and groves in Lucknow; certainly none has been collected from any of the gardens and other public grounds in my charge, and there has been no loss of trees in consequence.

For some years there has not been much lac on trees in Lucknow, at least on those in my immediate observation; but whether this decrease of lac pest is due to collecting being prohibited or to the seasons not favouring its spread, I am not prepared to pronounce an opinion, but the fact remains that it has been

much less in evidence for the past five or six years than it was for many preceding years.

I have often been told that the lac gatherers inoculate trees to spread and propagate lac. The results here rather favor that statement. Prohibition may have shown them that they gain nothing by spreading it, and this may have led them to cease inoculating trees ; but on this point conclusive and certain evidence is not forthcoming.

I most decidedly do consider that trees are injured by the way lac is generally collected, owing to the removal of such a large portion of the young twiggy growth of the trees.

Near, and in towns, the object of this free removal of twigs is two-fold : one to obtain as much lac as possible, the other to make money by selling the twigs for firewood. If proper and efficient supervision could be provided, lac might be removed to some extent by collecting dead twigs and a small proportion of the finer ones. The trees would not suffer to any appreciable degree if collecting was done in this way ; but, as the necessary supervision to ensure this is not available, prohibition is, in my opinion, the only safe method to follow.

The theory mentioned at the beginning of this note comes no doubt from persons interested in lac, and is a purely selfish one.

Others have accepted it from want of evidence to combat it, and so it has come to be generally accepted as fact. For this reason it would probably be useful to circulate the facts and experience given in this note.

Teak Plantations in Ceylon.

A few notes on teak planting may be useful to our readers, so we venture to give what has been our own experience.

The seed is as a rule obtained from India, and is of large size varying from one third to half an inch in diameter.

The plantations in Ceylon have, as a rule, been made from plants reared in a nursery, and plantations either from broadcast sowing or from seed sown at stake have not yet been tried sufficiently to give us any reliable data.

When plants have been grown in nurseries the following method has, as a rule, been carried out.

The land on which the nurseries are to be made is well turned over with mamoties, and all roots and stones carefully removed. Rectangular beds are then made not exceeding 4 feet in width, and length of about 15 to 20 feet. Between these, roads or paths are left for coolies to walk up and down when watering or weeding. The land is carefully fenced to prevent cattle coming in. These nurseries should be made in April or May, as planting in the low country always takes place in the North-East monsoon from November to January, and in order to have the plants 6 inches in height or more, they should be put out in the nurseries before the end of June. When the nurseries are ready, the seeds are spread out on the ground about 4 inches thick and constantly watered, the heat quickly causes them to germinate, and the coolies should be

put on the 3rd day to inspect the seed daily and to pick out all seeds that have commenced germinating.

If the soil is as it should be, rich in the nurseries, the seeds are placed 3 inches to 4 inches apart. The holes are picked to a depth of 2 inches, the seed carefully put in and covered over with earth.

The beds of the nurseries are watered every morning and evening, and in a fortnight's time the seed leaves will commence appearing above the ground. Should the sun be very hot every day, screens made of cadjans may be placed over the beds in the middle of the day from 10 o'clock to 4 o'clock in the evening to keep the mid-day sun off. Weeding should be carefully carried out, and by November the plants will be fully eight inches high as a rule.

Another system has been tried with the seeds and with equal success. Baskets commonly called supply baskets made of cane, and being about 4 inches in diameter and 9 to 10 inches in depth are carefully filled with rich soil and the germinated seeds put one into each basket. These are also watered daily and screened from the mid-day sun as is done with the nurseries. The great advantage of these supply baskets is that in planting out the plants afterwards no interference takes place with the root of the plant, and the plant suffers no shock when it is put into the ground. The objection to them is the greater expense; this amounts to about $\frac{1}{2}$ ct. per basket or Rs. 6 per acre.

Teak plantations are generally made on forest land, flat with good soil, not too much exposed to wind and well drained. Teak does not like swampy land. If there is any sale for firewood, the clearing should be commenced in the year as soon as possible, so that all the firewood may be removed. After this is done the remaining forest and undergrowth is felled and allowed to dry, and in July or August it is burnt off, a space should be cleared for about a chain at least round the piece intended to be burnt, or the surrounding forest may be damaged.

The clearing costs about Rs. 15 per acre, not including the cost of firewood cutting, on which a profit should be made by sale of firewood. In October when the first rains fall the ground is lined and holed for planting. The most successful distance for placing teak apart is considered to be 6 feet; this gives 1,210 plants roughly per acre. Lining or putting in pegs to shew where the holes are to be cut is, as a rule, done with a rope and prismatic compass. The rope has pieces of coloured cloth let in at every 6 feet. A base line is then laid down with the prismatic compass at right angles to the prevailing wind, so that it may do as little harm as possible to the plantation. This line is carried right along the length of the clearing, pegs being put in at every 6 feet where the coloured cloth is on the rope, sometimes double pegs are put in to shew that this is the base line. Then with the prismatic compass, cross lines are laid out at right angles to the base lines, 40

yards distant from each other. This prevents the lines from running much off the straight, and then the intermediate lines are put in, one end of the rope being held at the base lines, with one of the coloured rags at the pegs, and the other end held parallel to the first cross line; to test the further end being in line with the cross line, the man holding the rope at that end has a stick 6 feet long with which he measures from peg to peg. The pegs are generally split up 18 inches long, 1 inch square, and cost from 37½c. to 50 cents per 1,000.

Holing or cutting holes in which to put the teak plants in is generally done with mamoties, the holes are cut about 15 inches deep, the circumference varies according to the man and is immaterial, a cooly can cut from 150 to 200 holes per diem, cost per acre is about Rs. 2 to Rs. 3.

Planting takes place as we have said from November to January, and the sooner it is done the better, as the plants will get little rain after January, and should be allowed time to establish themselves; besides, if the planting can be finished early, there is often time to go over the clearing again and supply vacancies.

The plants are best taken out of the nursery with a three pronged fork, this is passed into the ground as far as possible by the side of the bed, and levered up thus lifting the plants. Great care should be taken not to pull the plants, as the rootlets get easily broken, and if the soil is at all hard, it may be advisable to water it well the evening before one intends taking the plants out. Planting is best done in cloudy weather, just after or before rain, coolies will not take care to plant carefully if it is raining at all heavily, and if it is dry the plants are liable to droop before they get a hold of the soil.

When planting, it is most necessary that the plant should be held in its natural position in the hole, the roots should not be bent, and the plant should be put in so that the roots are all in the ground and the commencement of the stem just flush with the surface of the earth. Earth should then be carefully placed all round and over the roots, and then the planter holding the plant in one hand presses the earth down, and if necessary puts in more earth. It is essential that the earth round the plant should be of the same height as the surrounding ground, as otherwise if there is a hollow, the water often lodges in it and causes the plant to rot off.

—*Ceylon Forester.*

The Dimensions of Trees.

We extract the following from Kerner and Oliver's "Natural History of Plants." Some of the certified dimensions are astounding and it would be interesting to learn further details in regard to these measurements. It seems incredible that a chestnut tree should attain a diameter of stem of 20 metres, about the length of a cricket pitch!

"The certified estimates of the heights of trees are of such general interest that they are included below in the following table:—"

Name.	Height in metres.
Peppermint tree (<i>Eucalyptus amygdalina</i>)	140-152
Mammoth tree (<i>Sequoia gigantea</i>)	79-142
Silver Fir (<i>Abies pectinata</i>)	75
Spruce Fir (<i>Abies excelsa</i>)	60
Larch (<i>Larix Europæa</i>)	53·7
Cypress (<i>Cupressus fastigiata</i>)	52
Scotch Pine (<i>Pinus sylvestris</i>)	48
Beech (<i>Fagus sylvatica</i>)	44
Cedar of Lebanon (<i>Cedrus Libani</i>)	40
Abele (<i>Populus alba</i>)	40
Mexican Cedar (<i>Taxodium mexicanum</i>)	38·7
Dürmast (<i>Quercus sessiliflora</i>)	35
Plane (<i>Platanus orientalis</i>)	30
Ash (<i>Fraxinus excelsior</i>)	30
Baobab (<i>Adansonia digitata</i>)	23·1
Arolla Pine (<i>Pinus cembra</i>)	22·7
Tree of Heaven (<i>Ailanthus glandulosa</i>)	22
Oak (<i>Quercus pedunculata</i>)	20
Hornbeam (<i>Carpinus betulus</i>)	20
Yew (<i>Taxus baccata</i>)	15

"*Eucalyptus amygdalina* consequently attains the greatest height of all known trees. The highest of these stems placed beside St. Paul's Cathedral would tower about 40 metres above the cross and would be only 4 metres lower than Cologne Cathedral."

"That the height and girth of trees do not increase proportionately will be seen by comparing the following table with the previous one" :—

Name.	Diameter of trunk in metres
Chestnut (<i>Castanea vulgaris</i>)	20·
Mexican cedar (<i>Taxodium mexicanum</i>)	16·5
Plane (<i>Platanus orientalis</i>)	15·4
Deciduous Cypress (<i>Taxodium distichum</i>)	11·9
Mammoth tree (<i>Sequoia gigantea</i>)	11
Baobab (<i>Adansonia digitata</i>)	9·5
Broad-leaved Lime (<i>Tilia grandifolia</i>)	9
Peppermint tree (<i>Eucalyptus amygdalina</i>)	8
Oak (<i>Quercus pedunculata</i>)	7
Yew (<i>Taxus baccata</i>)	4·9
Oak (<i>Quercus sessiliflora</i>)	4·2
Cypress (<i>Cupressus fastigiata</i>)	3·2
Elm (<i>Ulmus campestris</i>)	3
Silver Fir (<i>Abies pectinata</i>)	3
Abele (<i>Populus alba</i>)	2·8
Beech (<i>Fagus sylvatica</i>)	2
Spruce Fir (<i>Abies excelsa</i>)	2
Arolla Pine (<i>Pinus cembra</i>)	1·7
Ash (<i>Fraxinus excelsa</i>)	1·7
Larch (<i>Larix Europæa</i>)	1·6
Cornel (<i>Cornus mas</i>)	1·4
Scotch Pine (<i>Pinus sylvestris</i>)	1
Hornbeam (<i>Carpinus betulus</i>)	1
Tree of Heaven (<i>Ailanthus glandulosa</i>)	0·9

According to these certified estimates there actually exist plants whose stems attain a diameter of 20 metres, and others whose stems rise to a height of 152 metres above the ground."

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For little-known Trees.

Specialism is a feature of the age, and is no doubt a necessary condition of further progress, but it has its drawbacks, among which may be reckoned a certain narrowness of view, combined with a child-like ignorance of the innumerable generalities that go to make up life outside the laboratory or workshop. We foresters even, though we worship Mother Earth, and pay our vows at the breezy shrines of the Dryads, are not entirely so free as we might be. Certain "Improvement" fellings we wot of, in which the operations prescribed reduce themselves principally to two, the attempted extermination of climbers, and the real extermination of every species of tree, except *Shorea robusta*, and a few stems of *Adina cordifolia*. No doubt this may be financially sound, though the supposition that it is so is only based on our ignorance of the future, and of the real needs both of sál and of the market. Granted the soundness of the financial position, it remains impossible to grant that, of the biological one, until proof is adduced that the sál grows markedly better in the pure, or, as Mr. Macgregor would say, the unmixed, state, than it can with any admixture. It would further be necessary to prove that the soil under pure sál loses nothing by the absence of other species. Similarly, it would be necessary to prove that some of these other species could not utilise certain elements of the soil which the sál could well spare. Probably no forester would undertake to prove these points; therefore, the ban upon all other species is simply based on the present relative prices of sál as compared with them. Sál is no doubt the most useful timber in many forests, and it is necessary to produce it in preponderating quantities. But man cannot live by bread alone, and *toujours sál* would eventually become as monotonous as *toujours perdrix*. There is a similar tendency becoming visible, in a less marked degree, in teak forests. It is not

as though there were no other timbers worthy to be cultivated, for there are many that would find ample scope for utility in their place and degree, if they were but properly studied and introduced to the market. Many of these timbers, *Dalbergias*, *Terminalias*, *Sandal*, *Kheir*, &c., &c., are already well known and largely used, but there are still others which would repay development. By way of introducing these to public notice, a few were sent to the Chicago Exhibition. On seeing the proposed list, certain authorities objected, saying that the commercial woods were teak, blackwood, &c., and that these were sporadic trees, more or less curiosities, which could not be supplied in any quantity, even if they were any good. The reply was, that the regular trade trees were already sufficiently represented, and that they did not require further pushing, as the quantities actually cut were already based too much on the demand, and too little on the good of the forests; further, that the urgent need of the forests, from a cultural point of view, was the utilisation of the lesser known trees, which either cumber the ground, embarrassing the treatment, or are wasted; finally, that if a demand arose, they could be supplied and in some quantity at present, and could easily be multiplied, to the great advantage of the forests and the trade alike. These views are perfectly sound, but the assertion as to the ease of cultivation was perhaps a little premature. Take, for instance, *Schrebera swietenoides*, a tree somewhat local in its distribution, but by no means rare. The wood is hard, of a warm pale purplish brown colour, prettily veined, though without silver-grain, and produces a fine smooth surface under the plane. It would be an excellent wood for chairs, tables, cabinet work, and such uses. But can any forester say that he knows its seedling? The time of fruiting is known, but information is desired as to the time of germination, the appearance when small, the wants, general behaviour, and subsequent career of the seedling. Brandis does not give the time of fruiting, but the barren seed falls about December, and the good seed somewhat later. The Forest School would be grateful to any one who would be so good as to send a supply of fertile seed for experiment. The Guzerathi name, which Brandis does not give, is *pōpti*, or more rarely *ghant*; *ghaut* is a misprint.

Take again *Eleodendron Roxburghii*. The wood is very similar in appearance to the last, but less hard and lighter in colour. It is very prettily veined, pleasant to work, and suitable for turning and for much the same purposes as the *Mokha*. The tree is more or less common from the sub-Himalaya to Kanara, but does not usually attain the dimensions of the former tree. Brandis gives April-May as the time of ripening of the fruit, as is no doubt often the case, but the barren or injured seeds will be found falling at the present date, and probably ripe seed can be obtained by February, perhaps earlier. The name given in Brandis for *Bombax* is *Tamruj*, which may possibly exist, in some part of the presidency, the common names, when any is obtainable, are

Alan in the Guzerat side, and *Bhutkes*, *Bhuteakalas*, *Bhutuksha*, &c., in the Mahratta country. Ripe seed of this tree would also be thankfully received at the Forest School. Here, again, can any forester say he knows the seedling, its times and conditions of coming and going. If so, the *Forester* shall open its pages wide to welcome him in.

A third tree worth propagating is the *Hadang* of Kanara, *Eriolæna Candollei*, found also in Burma. The wood is of a walnut brown, but not so dark, sometimes with reddish veins and dark streaks, it cuts and works with the same ease, and shows an extremely pretty silver-grain. It would be suitable for fine cabinet work, picture frames, or, indeed, any coarser uses, for it is said in Mr. Talbot's book to be largely used for making carts. At the same time, few foresters probably know anything about its seeding and life history.

The above are only three trees, to begin with, belonging to the upper storey, for the same considerations affect also the lower storey and undergrowth. But first, to finish with the former, it may be noted that there are trees, to use a paradox, whose very worthlessness constitutes their value. *Bombax*, *Sterculia*, *Spondias*, &c., for instance. Any bunnia can see that teak and sál fetch a higher price at present than anything else, but it is the trained forester's duty to look ahead, and not to exterminate trees that may ere long have a much greater value. Now these apparently useless trees have a vocation beyond that of merely helping to constitute a mixture, namely, the paper industry. It cannot be supposed that this country will always be content to import foreign paper. On the contrary, we must expect that in the possibly near future, every locality will want its own paper mill, working up the produce of its own forests, and thereby saving the great cost of long transport. It is true that the utility of these trees for this purpose has not yet been ascertained, but that is mere negative knowledge, or rather no knowledge at all, for the probability of such a utility arising is sufficiently great to render unjustifiable any attempt to exterminate them.

As regards the underwood, the same considerations hold good. Up to the present, little or no attention has been bestowed on this category, but something might perhaps be done towards selective treatment. The lower storey often contains a mass of species that can never have any great utility, even as firewood; for instance, *Ehretia laevis*, *Holarrhena*, (in some books, perhaps, through confusion with *Wrightea*, fancifully compared with box) and many such. On the other hand, there are many small trees and even shrubs that produce a timber of value. *Wrightea tinctoria* is not bad, and might be a good enough substitute for box to suit native newspapers, but there is a shrub which gives something much more like the real article, namely, *Gardenia lucida* and *turgida*, whose wood is sometimes almost indistinguishable from it. *Randia dumetorum*, *Mallotus*, and a score of others are also worth prefer-

ential treatment, if any method of exercising it can be found. In short, there is an important branch of forestry to be developed, and it is the object of this article to point out a road by which working foresters may render services of the greatest value.

Kranji.

In the paper—*Indian Forester*, October 1896—on “*Timbers in the Straits Settlements*,” by Mr. Henry J. Child, presented to the Association of Surveyors of H. M. Service, supplement to Foreign Station paper on Singapore and said to be “based upon practical experience and from frequent visits to the timber ponds and saw-mills about Singapore, as well as information obtained from reliable sources during five years residence at this station,” reference is made to *kranji* as “a large tree growing to a height of 60 feet with a diameter of 4 feet, but is very uncommon in forests. The timber, which is of a dark colour and fine-veined, is very hard and durable.”

In his list of *Timbers in general use, Singapore*, Mr. Child gives the scientific name of *kranji* as *Dialium indicum*. There is no such species, but perhaps *D. indum* is intended.*

D. indum has been longer known than any Asiatic species of the genus. It was first made known to Europeans by Bontius, *Hist. Ind. Or.* p. 93, under the name *Carandje*, and it has been usual to assign to it in particular the Malay name *kranji*. It would appear, however, that the name *kranji* is generic in its significance and is applied to most, if not to all, the Malayan species of *Dialium*. For, while, according to Bontius, to Rumphius, and more recently, to Miquel and to Koorders and Valetton the name indicates only *D. indum*, field notes by Malayan botanists and collectors, on specimens in the Calcutta Herbarium, show that it may be applied to *D. laurinum* (Ridley 6437) to a form of *D. platysepalum* (Holmberg 221), to *D. Maingayi* (Curtis 440), and to what appears to be a form of *D. ambiguum* from Malacca (Derry 510 collected in 1892).†

According to Mr. Baker (*Flor. Brit. Ind.* II. 269) *D. indum* was not known from the Malay Peninsula up to July 1878. It has, however, since then been reported from Pahang by Mr. Ridley and from Penang by Mr. Curtis. There is no means of deciding from Mr. Ridley's field notes or from the references to the genus in his paper on the *Flora of the Eastern Coast of the Malay Peninsula* (*Trans. Linn. Soc. n. s.* Vol. III) whether *D. indum* is ‘wild’ in Pahang, but Mr. Ridley's silence on the point perhaps indicates that the tree may be indigenous there. With the Penang habitat it is otherwise, for Mr. Curtis' notes the specimens as being from “Ayer Etam in Miller's compound” and

* *Indum* was meant. We regret the mistake. — *Nonny. Ed.*

† There is another “510” collected by Derry in 1890, which is not the same; it is undoubtedly a form of *D. platysepalum*, but it bears the name *sepan*, not *kranji*. This affords an excellent example of undesirability of collectors, no matter how thoroughly acquainted with a flora they may be, giving the same number to two different gatherings.

has a doubt as to the precise name of the tree; this he gives as *Kranji burong* or *Kranji padie*. Both the situation of the tree and the dubiety as to its Malay name seem to indicate that it is a stranger in Penang. The name *Kranji padie* does not occur on any other specimen at Calcutta, but the name *Kranji burong* accompanies a form of *D. platysepalum* (Holmberg 855) from Malacca, characterised by having clavate instead of orbicular pods. Another specimen, for which alternative names are given, is an example of *D. Maingayi* (Goodenough 1533) from Malacca which is cited as being *Kranji ambot* or *Kranji s'kellat*. No other specimen bears the name *Kranji ambot*, but the name *Kranji s'kellat* is used twice (Derry 88; Goodenough 1693) for specimens, from Malacca, of the form of *D. platysepalum* with globose fruits. Still another name, *Kranji papan*, is used (Goodenough 1321) for a specimen of *D. laurinum*, but this name is used on two other occasions by the same collector (Goodenough 1225; 1553) for a very different plant,—the form of *D. platysepalum* with orbicular but distinctly compressed, not spherical pods.

There are several other species of *Dialium* in the Malay Peninsula, (*D. patens*, *D. Kunstleri*, *D. Wallichii*, *D. Kingii*) for which no native name has so far been reported, but as all have the same kind of fruit, and as it is with the fruit that the Malay associates most of his ideas of *kranji*, there is little reason to doubt that any of them may bear the name, with or without some added epithet.

The point, however, that it is wished to insist on, is that the *kranji* of Mr. Child's paper may fairly well be any one of nine different trees, though with every probability of its *not* being the species that he supposes it to be.

Malay names are apparently quite as vague and unreliable in their incidence as Indian names can possibly be, and the present case affords an excellent instance of the risk that is run when reliance is placed upon them. And there is no certainty that the identity of the other timbers enumerated by Mr. Child is less obscure than the identity of his *kranji*.

D. PRAIN.

A Legal Question.

Perhaps some of the readers of the *Indian Forester* will be good enough to give me an answer to the questions at the end of the following :—

A Government contractor has a contract to work timber from a certain forest, a portion of which is drained by a stream, in which floating operations are impossible above a certain point, the only practicable alternative being carting. He finds, however, that :—

- (1) Across the only track, along which carting is possible, a *taungya* has been cut and planted ; and
- (2) between the point at which the carting track leaves the forest proper, and the stream there is a stretch of paddy fields (State land) which are cultivated at irregular intervals, depending upon the rainfall.

Under Rule 4^a (1) of the rules under the Upper Burma Forest Regulation, timber may be transported across any land under the authority of the Deputy Commissioner or Divisional Forest Officer. Under clause (2) of the same rule, however, 'if any damage is done to private property by the transport of such timber, such compensation as the Deputy Commissioner may adjudge to be reasonable, shall be paid therefor.'

The contractor claims that according to his contract he is granted "full and free right of ingress, egress, regress, passage and way into and from" the forest in question, and that, therefore, he cannot be called upon to pay the compensation, which should be paid by Government.

The questions to which I want replies are—

- (1) In the event of timber being carted across the lands referred to, can any compensation be legally claimed, at all, by the cultivator of (a) the *taungya*, (b) the paddy fields? and, if so
- (2) From whom should the compensation be claimed?

I hope I have succeeded in stating the case clearly, but the following notes may be of assistance :—

1. Special permission had not been obtained to make the *taungya*.
2. The rotation under which it was worked was irregular.
3. The right to cultivate the paddy fields would probably be allowed.

H. H. F.

We should say that the cultivators are bound to leave a right of way open to the forest, and have no claim for compensation.—Hon. Ed.

Bassia latifolia.

I send by this post some flowers of *Mahwa* (*Bassia latifolia*) which were gathered by Mr. Mansukh Rai at Lohara in the Wun District (Berar) at the end of October 1896.

Mahwa usually flowers in March-April, and the present early flowering can only be attributed to the early cessation of the rains.

Mr. Mansukh Rai will be glad to hear if early flowering of the *Mahwa* has been observed elsewhere.

C. BAGSHAWE.

Chestnut and Robinia as Forest Trees.

The September number of the "*Allgemeine Forst and Jagd Zeitung*" contains an interesting article on the chestnut, *Castanea vulgaris*, and the robinia, *Robinia pseudacacia*, in Upper Elsass; and as the cultivation of both these trees is of considerable practical interest for all forest officers in India, (at least in the more northern provinces) we would draw their attention to this paper. As yet the chestnut has been cultivated in India (in the Punjab and North-West Provinces) only with a view to its fruit production, but the tree is of even greater importance as a timber tree, more especially for the production of small poles, and it yields at the same time excellent firewood.

Both in Upper and Lower Elsass the chestnut is found intermixed in high timber forests, and yields excellent scantling, but it is chiefly cultivated in coppice forests with a rotation of from 14 to 16 years. It is under this treatment that the tree yields its most excellent results, and produces poles 20 to 24

inches in circumference, measured above the swell at the bottom, and 36 feet long. The wood, moreover, is of excellent quality, and as the sapwood resists exposure to a much greater extent than that of the oak it is mostly used in Upper Elsass as vine props. Chestnut poles left standing all winter in the ground will last 25 years without being changed or moved, and remain useful when left thus for another ten years with an occasional re-pointing. Owing to the enormous yield per acre, and their lasting qualities, poles of chestnut, and to a less extent robinia, alone among timbers, can hold their own against cheap impregnated fir poles.

As regards habits and cultivation, the following notes, culled from Mr. Hallbauer's paper, may prove instructive. Both the chestnut and robinia favour a loose soil, especially the latter species, which refuses entirely to grow on a binding or hard soil. On the other hand, the robinia is much less exacting as regards depth or richness of the soil, owing to its immense system of surface roots. Both trees require a fairly well drained soil, the robinia even more so than the chestnut, and though they will grow in moist localities, especially on loose soil, they begin under these conditions to develop heart-rot at an early age.

As regards cultivation, the trees are very similar, and the best results have been obtained by planting one-year old plants on lands which had been ploughed and cultivated for two or three years. Both trees grow extremely rapidly, and reach maturity at the early age of between 12 and 16 years. It is for this reason essential that, when they are intended to be treated as coppice, the seedling plants should be cut down to the stock at an age of between 6 to 8 years. It is evident that the first crop will, under such circumstances, give a comparatively small yield of material useful only for firewood, but this initial loss will be amply repaid by the more rapid and denser growth of the future coppice crops.

The chestnut is a shade-enduring plant, as its struggle for existence is both intense and prolonged; early thinnings, even of coppice, are therefore advisable. The robinia, on the other hand, is light-loving, and no interference with its struggle for dominance is called for. The chestnut forms humus rapidly, and is a great soil-improver. The robinia, also, in spite of its light foliage, tends to improve the soil, though of course not to the same extent as the chestnut. Its leaves, however, decompose rapidly, and form a good natural manure, which favours the growth of tender grasses. It would for these reasons probably form an excellent standard in tea gardens or on grass farms. Standards of chestnut, even in localities where they do not yield large fruit, are of considerable value, as the wood is specially prized by carriage builders.

The coppice production of both the chestnut and the robinia is, in suitable localities, larger than that of any other species cultivated in Europe, and their experimental cultivation in India would seem to indicate that similar results may be achieved in this country.

The Dimensions of Trees.

In our last issue we called attention to some trees of extraordinary dimensions recorded in Kerner and Oliver's *Natural History of Plants*, we now add some notes of measurements of large trees of Indian species which may be of interest.

Cedrus Deodara. A section of a Deodar tree from the Jaunsar forest in the Forest School museum measures 27 feet in girth and shows 665 annual rings.

Cupressus torulosa.—Brandis' Forest flora mentions a cyprus tree measured by Dr. Steward which was 27 feet in girth near the ground.

Tectona grandis.—Teak trees of enormous size are not infrequent in Upper Burma. A felled log in the Yamèthin forest measured by S. Carr was 64 feet long and 13 feet 9 inches in mean girth; it was perfectly sound, and, when found, was in process of being split up to build a Buddhist monastery. In the Myittha—Panlaung forest there are two immense teak trees standing side by side, the largest of which was found by H. Calthrop to be 20 feet in girth at 6 feet from the ground with a height of 60 ft. to the first branch; and at Alaungdaw-Kathaba in the Chindwin a tree measured by C. E. Muriel girthed 17 feet 4 inches at 5 feet from the ground.

Bombax Malabaricum.—We have a photograph of a tree said to be 87½ feet in girth one foot from the ground, but it is believed that the measurement was taken along the contour of the buttresses.

Santalum album.—As a record measurement of a tree of the smaller classes may be mentioned a sandal tree felled by A. E. Lowrie in Coorg which measured 5 feet 6 inches at 5 feet from the ground.

Reforesting Waste Lands in Holland.

There is a society in Holland called the *Nederlandische Heide Maatschapij*, with objects similar to those of the New Jersey Forestry Association, with an official bi-monthly organ. It is encouraging to those interested in similar societies in America to know that the *Heide Maatschapij* and the similar society in Denmark, after which it was modelled, have been successful in many respects. It is also gratifying to learn that even in Europe a great deal of what has been accomplished is due to societies similar to the State associations of the United States. The objects of the Holland society are to promote the exploitation of the dunes, heaths and other desert places, to give advice, form nurseries, and sell trees at cost price, to educate the people in the principles of forestry by distributing literature and by delivering lectures and

to encourage the Government to improve the waste land which it owns. It has a membership of two thousand. Every member pays two gulden annually, but there are many honorary members and patrons who pay much larger sums for its support. This association has already accomplished a great deal. It has induced the Government to continue the work of foresting the dunes, for which twenty thousand gulden have been already appropriated for experimental purposes, and the work is under the direction of the society, and two nurseries have been formed in which many seedlings for dune planting are grown. This association has induced individuals to improve their waste lands, and contemplates buying and improving heath land for example's sake. The society is under the directorship of Mr. H. J. Lovink, an able and enthusiastic forester.

The Dutch dunes are similar to those of New Jersey, and unless the soil is covered it is shifted by wind and wave. More than four thousand acres of land in the neighbourhood of the town of Bergen is owned by the Government. This is very much like the dune land near Avalon, on the Jersey shore. There are residences surrounded by large trees in the lee of Dutch dunes, but everything has been planted, even the famous forest between the Hague and Scheveningen, the Atlantic City of Holland, and it will cost the Government at least two hundred thousand gulden to plant its dune lands in forest. Many private holders in this region are not in favor of this work, some preferring to see it in its unproductive state, mainly for hunting purposes.

The principal game, however, is rabbits, and their extermination has been decreed because they are very destructive. Thirty years ago experiments were begun by the famous geologist Staring for the planting of the dunes, but the work was frowned upon and discontinued; the trees which he planted still remain.

In the eastern and southern parts of Holland there are vast stretches of rolling heath lands, a continuation of the Luneberger Heide in Hanover, which stretches through Schleswig-Holstein and Denmark to near the Zuyder Zee, in Holland. The soil is sand and gravel, mainly glacial drift, in which may be seen irregular ice-worn pieces of rock from the *Scandinavian Peninsula*. There are reasons for believing that at one time this region was in part forested. The names of places in old Dutch often mean forest or wood, and Mr. J. H. Schober, the pioneer of heath-planting in Holland, found part of the trunk of a large oak buried deep in the ground in his plantation at Schovenhorst. A few sheep can live upon the scanty herbage, and as soon as a little humus forms on the surface it is removed by the peasants to mix with manure. The bearing force of winds and rains has compacted and leached the surface soil. Low heather and crisp lichens cover the ground, reminding one of the sterile fields in Southern New Jersey. It is even more barren than the fire-swept plains of Ocean County, in that State. With work, this whole

heath can be reclaimed. The huge experiment which Mr. Schober has had the patience and patriotism to begin proves that trees will grow there. A careful working and a little enrichment of the soil are all that are needed at first. When Mr. Schober began his plantation at Putten forty years ago it was all a desert heath. Conifers from all parts of the world are growing there luxuriantly, and, although his experiments will not be complete for years to come, they show, at least, that a great variety of conifers will grow on the heath-lands of Holland, and that certain species are, of course, much better adapted to the soil and climate than others. Many tests must be made before conclusions as to the very best varieties are warranted. Mr. Schober has planted also large quantities of Scotch Pine, from which he receives a revenue. This wood is cut and carefully sorted, and the poles are shipped to the Belgian mines. What surprised me most on this remarkable plantation was to see species from the Rocky Mountains and the Atlas Mountains thriving in these heath-lands. The most beautiful trees in this large pinetum, as I saw them, were *Abies nobilis* and *Cedrus Atlantica*.

A great deal of private planting has been done in Holland with very little encouragement from the Government. In the southern part there are large areas in Scotch Pine and coppice Oak. The Willow has been planted in immense quantities along the Lek, the Rhine, the Maas and Waal. In the sandy heath regions much of the soil has been improved by planting one of the Lupines, *Lupinus luteus*, a beautiful plant which may be useful in America as a green manure, since it seems to flourish on very sandy soil. The American Locust, *Robinia pseudacacia*, is a favorite tree here, since it grows well on poor soils, and it is quite the custom to plant it along railroad embankments. It is also a favourite shade-tree in many German cities, and, when properly trimmed, it has few equals for the purpose. Our Wild Cherry, *Prunus serotina*, also seems to thrive on the heath-lands.

Amsterdam, Holland.

JOHN GIFFORD.

—Forest and Garden.

Recent Advances in Agricultural Chemistry.

In 1886 and 1888 there were published the important discoveries made by Hellriegel, Willfarth, and Beyerink, that the power of fixing the free nitrogen of the air, which leguminous plants possess, was, firstly, connected with the presence of certain small nodules growing on their roots, and, secondly, was caused by special bacteria growing in these nodules. Since then, rapid strides have been made towards the utilisation of these facts. By the labours of Dr. Nobbe and those associated with him, pure

cultivations of these bacteria, for purposes of inoculation, are now sold as an article of commerce under the name nitragin. In consideration of the value of this work, the Royal Agricultural Society lately directed Dr. Voelcker to proceed to Germany and investigate its progress. The information so gathered is to be found in detail in the Society's *Quarterly Journal*. It occurred to Dr. Nobbe that amongst the mass of bacteria growing in the nodules on any given plant, certain of them might be specially suited for the growth of that plant. He therefore endeavoured to isolate, by a process of pure cultivations, the supposed specific bacterium for different leguminous plants; and although no microscopic differences can be detected between the growths which he has thus sorted out from each other, a great diversity of action is exhibited when they are practically tested.

Thus it is found that each special cultivation is extremely potent with the species of leguminous plants from which it was originally obtained, and somewhat less active when used to inoculate closely-allied species; but quite without effect upon distant members of the order. There have also been isolated neutral bacteria, which have a greater or less effect on all the members of the leguminous order. These, moreover, after growing on the roots of any given species, become so modified that they lose their general activity and assume a special one. As a result of this scientific work, no less than seventeen varieties of the organism suitable for as many leguminous field-crops are now sold by a German firm at the price of half-a-crown a bottle, which quantity is sufficient to inoculate half-an-acre of land. The process of inoculation, however, has not been equally successful in all kinds of soil, and in one case of failure the active cause was supposed to be lime, as the treatment of a marl-treated plot has been successful. To discover whether this was indeed the true reason, comparative experiments on a small scale were made on both sandy and peaty soils with lime and marl, respectively, as manures (1). The result of these pot experiments showed that the presence of lime, instead of being injurious to the bacteria nodules, was a considerable aid to their development, and, in the case of peaty soils, was really necessary, so that the field-results which suggested the experiments are still unexplained.

Other workers (2) have shown that a calcareous soil is advantageous for the growth of pine trees, the most conspicuous effect produced by a deficiency of lime being the production of short needles. If, however, magnesia is present with the lime, it acts injuriously, unless the relative proportion is very small. This last fact has been amplified by other experiments (3); these show that it is only the chloride of magnesium which is injurious, the other and less soluble salts being probably innocuous in the pre-

(1) Take, *Mitt. Ver. Fö-d. Moorkultur*, 1895, 13.

(2) Loew & Honda, *Bull. Coll. Agric. Imp. Univ. Tokyo*, 1896, 2.

(3) Larbalétrier & Malpeaux, *Ann. Agron.* 1896, #2.

sence of lime.

The latter is also of great use as a manure for tobacco, when grown on soils poor in this ingredient. The combustibility is thereby considerably increased, potash not being so useful for this purpose as was supposed (⁴).

The disappearance of nitrates from soils is a matter of considerable importance, and has met with some attention. It has been found that certain kinds of manure, if used together, caused a great loss of nitrogen (⁵), and this was attributed to denitrification by ferments. In 1890 the presence of such denitrifying agents in straw and other vegetable substance was demonstrated (⁶), and it is now experimentally proved that soil when watered with a preparation of these germs rapidly loses nitrogen. A similar result can be produced by consolidating the ground so as to check aeration (⁷).

The influence of various chemical reagents on germination has been studied. An elaborate paper on this subject has been published, containing the results of 275 experiments arranged in 17 series (⁸). The more important conclusions may be summarised as follows :—Mineral and organic acids are injurious to germination, and strongly acid salts are more injurious than neutral salts. Free bases and strongly basic salts are poisonous. Salts, generally, are either injurious or without effect. Fats and ethereal oils prevent the germination of corn, and much retard peas and rape. Anaesthetics and hydro-carbons, generally, retard germination, while their vapours kill the seeds. Organic antiseptics are all injurious in solutions of more than 0·1 per cent., and coal-tar dyes also in solutions of 0·05 per cent. The influence of the various constituents of artificial manures in solutions of 0·05 to 0·5 per cent. has been examined (⁹). It is found that they are injurious to germination, but grains are more resistant than other seeds to their action. Lime water and basic phosphates, however, are very beneficial, especially to leguminous seeds. Sulphuric acid, even in very dilute solutions, is highly injurious, and as a considerable quantity (·108 to 1·612 per cent. by weight) is produced in the germination of seeds, it seems evident that it is the power which lime possesses of combining with, and neutralising, this acid that is the secret of its value.

(4) Cserhati, *J. Landw.*, 1895, 43.

(5) Wager, *Journ. Agric. Prakt.*, 1895.

(6) Bréal, *Ann. Agron.* 1892.

(7) Bréal, *Ann. Agron.* 1896.

(8) Sigmund, *Landw. Versuchs. Stat.*, 1896, 47.

(9) Claudel & Crochetelle, *Ann. Agron.*, 1896, 22.

Imperial Institute Journal.

The inquiry by Dr. Nobbe took three distinct lines :—

1. What the nature of the process was by which leguminous nodule-possessing plants were enabled to assimilate free atmospheric nitrogen.

2. How the working of the nodules manifested itself in soils of different degrees of richness in nitrogen.
3. Whether the bacteria originating from the nodules of different kinds of leguminous plants were all of one and the same kind, or if each group of leguminous plants had its particular nodule activity.

As to 1, Nobbe concluded that, like the green plant, the bacteria could not by themselves assimilate free nitrogen, but that they were gradually changed in the nodules to a particular form known as "bacteroids," and that it was by virtue of their network arrangement in the cell of the nodules, which presented the largest possible surface to the air that they were enabled to absorb the free nitrogen of the cell sap and render it assimilable by the plant.

In regard to the second point, Nobbe found that the working of the nodules attains its full efficiency only when the soluble soil nitrogen was nearly used up. Accordingly, the more nitrogen that the soil contained capable for being taken up by the plant, the less was the difference between plants that had been inoculated and those that had not. As a consequence of this, quickly growing leguminous plants, such as peas, vetches, and the like, that used up the nitrogen of the soil quickly, showed the influence of the inoculation much more rapidly than did clover, lathyrus, &c. In the end, however, the inoculated plants possessed an advantage in that the demands of leguminous plants for nitrogenous food are exceptionally high.

The third question is the one of most importance to us at the present time. Nobbe showed, by his experiments, that though the bacteria from the nodules of leguminous plants of different families were in outward appearance scarcely to be distinguished from one another, yet in their behaviour to plants they showed very marked differences. The bacteria from nodules of the pea, for instance, acted admirably when used for inoculating the pea plant, and also did somewhat less well when used for vetches (which are nearly related to the pea), but they did not do at all when used on clover, serradella, robinia, &c.

Similarly, bacteria from the nodules of red clover, robinia, &c. would answer with those kinds of plants from which they originated, but had no action whatever on peas. From this, Nobbe drew the conclusion that every leguminous plant is most influenced by bacteria of its own kind, though bacteria of nearly related kinds can replace one another to a certain extent, but that bacteria from leguminous plants belonging to families widely separated from one another, either form no nodules at all, or only small ones with no appreciable influence on the supply of nitrogenous nourishment.

No absolute distinction, however, could be drawn respecting the activity possessed of the bacteria of nodules of different families of leguminous plants. For it was one only of degree. Pure

cultivations of unlike origin represented not special kinds, but only adoptable forms; these were able in a weaker degree to enter into symbiosis with all the families; these were the *neutral* bacteria. If one such form entered a leguminous root, and, while forming nodules, in it, increased, its descendants would be influenced by the parent plant so energetically that they would only possess the full power of working in the case of leguminous families of the same kind, but they would lose it more or less for all others. On sowing, therefore, in any particular soils, nodules can only be formed with certainty when the neutral bacteria, or the form of bacteria adopted for the particular kind of plant in question, are present in sufficient quantity. If in a soil already exhausted, more or less, by heavy leguminous cropping of its neutral bacteria, there be put in another leguminous plant which is not closely related to the previous one, there will no longer be the conditions present for the formation of nodules, or else this formation will be so meagre that it has but little value for the nitrogenous nourishment of the plant. Hence, wherever there are no nodule—bacteria in soils, or these are present only in small quantity, the lacking bacteria should be artificially supplied by inoculation of the soil, through the medium of the proper “nitragin” for the crop in question.

In preparing “nitragin” for commercial use, Nobbe and Hiltner took the “pure cultivation” obtained as already described, transferred it, with suitable precautions, to a glass bottle holding 8 to 10 oz., and containing at the bottom a small quantity of agar-gelatine on which it was then allowed to grow; the bottle was sealed and the contents kept from the light. In this form then “nitragin” is available for use, and can now be purchased by anyone desirous of trying it.—*Tropical Agriculturist*.

The Nutritive Process in Plants.

(PROF. J. REYNOLDS GREEN, D. SC., F. R. S.)

Carbohydrate reserve materials are not always deposited in the shape of starch grains. The roots of our biennial plants furnish us with examples of another kind of store. If we examine the root of a beet or a mangel wurzel we find that the succulent substance is distinctly sweet to the taste. This sweetness is due to the presence of a solution of cane sugar in the sap. The cells are very turgid with water, and this contains a large percentage of cane sugar. Indeed, the manufacture of sugar for the market from beet-root is, as is well known, of great commercial importance. The sugar here remains in solution, and is not deposited as starch as in the former case. We cannot, however, think of it as remaining unchanged after its transit from the leaves. The process of its formation is much like that of the potato at first. But when the leaf starch has been converted into sugar, that sugar is malt sugar as

before, and it is transformed into cane sugar after its arrival in the root.

An onion affords us an instance of yet another kind of carbohydrate deposit. Here the fleshy leaves of the bulb, wrapping it so closely round as to form a very solid body, are charged with an accumulation of grape sugar, a third kind differing from both malt sugar and cane sugar, such as we have seen to occur during the processes already described.

The chief form of deposit in seeds is that of starch, which is the most stable body and the least liable to disturbance. This, no doubt, is why it is adopted by the plant for this reservoir, as generally a longer time, indeed in some cases a very prolonged period, passes before it is called upon to supply nourishment to the young plants. Carbohydrate material is thus stored in many forms and in various places in the plant. Similarly nitrogenous material or proteid has its appropriate reservoirs. We have in many seeds, particularly leguminous ones, stores of this material in the form of definite granular aggregations, which botanists have called *aleurone grains*. If we take, for instance, the pea or bean, we see that the cells contain embedded in their protoplasm structural elements of two sizes. The larger shows the curious concentric marking peculiar to starch, the smaller shows no structure. Instead of turning blue when treated with iodine, they become brown or brownish yellow. These small grains are the aleurone grains, and are made of proteid. This substance is not all uniform in its properties; indeed, we are familiar with many kinds of proteids, which differ very considerably with regard to the fluids in which they will dissolve. Those proteids which most readily occur to our memory are the albumen or white of egg, the globulin of muscle, the fibrin of blood and so on. Though the vegetable proteids are not met with in the same condition exactly as the animal ones, they are nevertheless very much like them in their composition. The aleurone grains of the pea have very striking similarities with the globulin found in muscle. A good deal of the substance is soluble, like that, in a ten per cent. solution of common salt, and salt added to saturation to such a solution of the proteid precipitates it in the form of an amorphous mass. Parts of some aleurone grains are soluble in water, and resemble some of the soluble proteid, of an animal digestion. The albumen or white of egg is very much like a proteid which is found on the underground parts of the asparagus, which must be accordingly called a vegetable albumen.

If we wish to study the deposition of proteids in these vegetable reservoirs, we turn to the seeds rather than to other parts of the plant. In seeds they are very common. The pea and bean have been alluded to; here they occur in conjunction with starch. Other seeds, such as the rape and the linseed, show them associated with oil. In some seeds they are distributed through the whole substance of the embryo; in others they fill the endosperm; in the wheat and barley they occupy a single layer of cells just underneath the outer covering.

In most of the seeds produced by our cultivated plants, the aleurone grains are very simple in structure; indeed, they show no structure, being little rounded masses of granular-looking material. In some foreign seeds, particularly the seeds of the castor oil and the Brazil nut, they are much more complicated. In our own flax we have similar ones. Various solvents need to be used to show the structure, which consists of the following parts. There is an oval casing or matrix, part of which dissolves in water, and the rest in 10 per cent. solution of common salt. Embedded in it is a large regular crystal of proteid matter, which will only dissolve in a saturated solution of salt. This is known as the crystalloid. Between this and the outside of the grain is a rounded irregular mass of small crystals of the double phosphate of magnesium and calcium, which is known as the globoid. This of course is not proteid, though it is always embedded in the grain.—*Tropical Agriculturist*.

An American View of Indian Forestry.

India, says a contemporary, would scarcely be looked to for an example of forest preservation, but that country has perhaps the finest national forest policy of any in the world. Before regulations for the conservation of growing timber had been devised and put in force, its forests had been consumed as recklessly as those of the United States, and that is putting the case as strongly as is necessary for emphasis. Fires destroyed, timber for use was cut lavishly and without regard to economy, and the forests were disappearing under careless treatment. Through the present policy India has placed 80,000 square miles under permanent regulation, while 50,000 other square miles are in process of settlement. A large number of trained men now constitute a force to protect the forests. The revenue from these reserves is expected to equal the expenditure for the entire preservative machinery. The product of the forests brings in a liberal and growing surplus. This policy has been in operation for thirty years and has been a great success.—*North Western Lumberman.*

Forestry in Ontario.

The annual report of the Clerk of Forestry for Ontario, Canada, Mr. T. Southworth, gives a general review of the progress and present position of the science of Forestry, with an account of its practical development in the United States.

The forestry problem in Ontario, in its broader aspects as concerning the Crown domain and the policy of establishing forest reserves, is dealt with, reference being made to Algonquin Park and reforestation experiments therein. The results of an inquiry into the working of the Ontario Tree Planting Act of 1883, the observance of Arbor-day in schools, and the effects of clearing the forests in Southern Ontario upon the water supply, are stated at length, and some statistics are given in connection with the great lumbering industries and the growing consumption of timber in the manufacture of paper pulp. The area of the timber-bearing lands still belonging to the Crown in Ontario can only be approximately estimated. In 1893 there was about 21,000 square miles of pine lands under licence, and 24,410 square miles of pine lands unsold. These areas are exclusive of 89,000 square miles, which are more or less timbered, but as they are not supposed to have large quantities of pine upon them, no account has been taken of them by the Crown Lands Department. Taking 80,000 square miles as the timber area of the province—certainly a very low estimate—and reckoning the annual addition of timber over this area at 60 cubic feet per acre, the total addition of timber each year, exclusive of tops and branches, would be 3,072,000,000 cubic feet. According to the report of the Commissioner of Crown Lands for 1894, the timber cut on the Crown lands of all kinds amounted to 60,695,250, cubic feet for that year. This would leave the annual growth, in excess of the annual cut, as 3,011,304,750 cubic feet. Unfortunately, the amount of timber destroyed by fire probably exceeds that cut down by the lumbermen, and if fires could be prevented, or even very much lessened, the present rate of cutting on Crown lands could be continued indefinitely.—*Imperial Institute Journal*.

The Woods of Samoa.

Much has been written about Samoan woods, their beauty abundance, and variety, but, says the United States Consul-General at Apia, there is but little foundation for the statement that these woods are likely to become a source of marvellous wealth. There can be no question but that the variety of woods is very extensive and that a limited proportion may in time become valuable. Most of the Samoan woods are very soft and light, and, after becoming well dried, lose not only a great proportion of weight, but become brittle, and of no practical worth to sustain lateral strain. In addition to these there are several varieties of hardwoods, such as the *ifelele*, *talua*, *pau*, *toi*, *niala*, *tau* and the *ifi* (*Inocarpus edulis*), which can scarcely be said to be abundant. Several of these are

beautiful, very hard, and susceptible of a high polish. One or two varieties grow to a fine size, and are in request among the natives for making kava bowls—wide, shallow vessels hollowed out from cross sections of the butt of the tree, generally from 18 in. to 2 ft. in diameter, and sometimes reaching 3 ft. 6 in. in width. Woods employed for this purpose would doubtless cut into veneers, were there a demand for their peculiar colour and grain by the fancies of fashion. Such, however, does not at present exist, and there is no probability that the mere eccentricity of taste will take a direction to create a demand. A large amount of hardwood is used in making the common canoe of the natives. These are mere logs, hollowed out, and the largest, with rare exceptions, would not require a log more than 2 or 3 ft. in diameter. These canoes are laboriously hollowed out of the log, on the ground where the tree is felled, being hewn away until the boat is a mere shell of from 1 to 1½ in. in thickness, except at the bow and stern. When thus lightened to a minimum, they are dragged and carried to the water. While large trees are numerous, they are not in proportion to the extent covered by the forest, or to that common in a country of merchantable timber, plentiful, or found close together. The dense character of the tropic forest, the deep shade, moisture, and heat have naturally, in such a climate, the influence of so thickly crowding the surface with shoots and young trees that the forest is a mass of slender saplings, overcrowded and dense, all under stimulus of the need of light and air, towering to reach the open space above. In such a bush the largest trees having attained size on some principles of survival of the fittest abound in necessarily limited abundance. These large trees, of nearly all varieties, flare out at the butt in ribs or inverted brackets until they cover a space at the surface of from 12 to even 20 ft. The woods are not of straight grain but are twisted, knotted, gnarled, and contorted in shape, and this bent and knotted quality in the hard and tough varieties produces a most excellent material for knees in small and medium-sized wooden vessels, for which it is much used. In a general sense, it is, perhaps, in this employment that Samoan woods find their greatest value. Much was expected in years gone by from the production of fibres, and an array of plants was cited producing fibres of a merchantable character. The intervening years have allowed the shipments of various samples to Europe for experiment, but the experiments were such that no encouragement or demand followed. The fibre obtained from the covering of the cocoanut is practically the only one produced in the Samoan islands. This article is well known to commerce, and long ago took a place in the manufacture of mats, and, to some extent, as a substitute for hemp in twines. In all cocoanut-growing countries it is, of course, abundant, in proportion to the production of mats. In Samoa it is used by the natives in making all the twine and small rope their needs require and does not enter into export.—*Timber Trades Journal*.

India Rubber.

India-rubber is in a fair way to become one of the prime necessities of civilisation. Numberless human beings, in the class which could not afford wet-nurses, owe their lives to the feeding-bottle. Everybody knows that in the last five years the use of pneumatic tyres for cycles and solid rubber tyres for horse-vehicles has enormously increased our consumption of this article; but quite apart from that more obvious fact, india-rubber is daily being introduced more and more into all sorts of machinery. Highly competent judges say that if the output could be doubled within a year, so many new applications of the material would instantly arise, that the price would not fall appreciably. As a matter of fact, the export of Para rubber has increased within the last twenty-five years from 5,600 tons to 20,000 tons; and the price fetched by the best quality has risen from 2s. to 3s. a pound. It is the one jungle product which society finds indispensable. Hundreds of men have racked their brains to produce a substitute, but none has in the least degree succeeded; and such attempts must be permanently discouraged by the knowledge that india-rubber exists in limitless profusion upon known spots of the world's surface which may at any time be made accessible. In any of the swampy equatorial regions, where vegetation grows rank and sappy, so that a knife will slash through branches as if they were made of cheese, there is pretty certain to occur some one or two of the score of trees which produce rubber. Whole forests of them are known to exist in Central Africa, only waiting to be tapped. But the regions which produced them are precisely the regions most deadly to the white man; and when the rubber is made it has to come to the coast on the heads of negroes, and will not pay the cost of transport. When an accessible forest is discovered it pays like a gold-mine. A tree was discovered near Lagos which was believed to produce rubber; specimens of bark and foliage went home to Kew, and the authorities pronounced it the right thing. In 1895 the export began, and amounted in the year to 2,263 tons, with a value of £270,000 in round figures.

India-rubber would seem to be the one certain source of wealth now locked up in Central Africa, and perhaps the most valuable thing that the region produces or can produce. Ivory is only a fancy article, and palm-oil has many substitutes. Gold no doubt exists there, but, in the first place, it is doubtful whether the pure negro can be made into a miner; and in the second, gold is to be got in regions where white men can live. It seems, therefore, as if the special function of the tropics just now was to produce india-rubber, which is wanted everywhere and cannot be grown elsewhere. No cultivation is need; Nature requires of man very little skill, scarcely any exertion, and only a reasonable avoidance of waste. Yet this is asking more than the African negro is at

present able to give. The great rubber-producing region of the world is the basin of the Amazon, which yields about two-thirds of the entire annual output. The quality of this rubber is immensely superior to all others; the best Para will fetch in England as much as 3s. 6d. a pound; the worst African goes for under a shilling. Brazil has, of course, an immense advantage in its great waterway; ocean-going steamers run twelve hundred miles up the Amazon, whereas every African river, except the Congo, has a bar at its mouth, and cataracts not far distant from the coast-line. On the other hand, the forests in Brazil seem even more impenetrable than in Africa. Not even such roadways as the African man-paths can be maintained against the encroachment of the jungle. But the native Brazilian race is incomparably more intelligent than the negro. Their caoutchouc is better prepared, and what is far more important, they farm the trees as carefully as the Red Indians used to farm the beaver. In Africa the rubber is generally produced not from a forest tree, as in Brazil, but from the *Landolphia*, which is a climbing shrub. The negroes deal drastically with this, and simply cut it down, and then get what milk they can out of it. So, year by year the rubber-trees are destroyed, and year by year they have to go further afield to seek them. If they are left to themselves they simply cease to produce india-rubber, and there is an end of it. If they have the fortune to live in the happy Congo State a certain amount of the stuff is exacted annually from each village; when the trees within reach are exhausted, the collector comes round, finds no rubber, and goes home with a string of ears and noses instead. No doubt the West Coast negro is a trying person to deal with, but these methods have been so long employed unsuccessfully, that civilisation, we hope, may discover a better way, and educate the black man instead of torturing him. One is sorry, therefore, to hear that at Lagos, where the rubber is being produced from a forest tree, the *Kicksia*, the natives have been allowed to over-drain the trees of their milky sap and stop its production. The supply of rubber-producing plants in Central Africa is practically inexhaustible; but the number of places where they exist within easy distance of some export station is small, so far as our present knowledge goes. Yet for the present, speculators will probably hasten to be rich, and if they hit upon a forest will treat it like a mine, anxious simply to take out the maximum at the minimum of cost.

Whether our State, or any other, will ever make this a great branch of its tropical forestry remains to be seen. The Germans, with their usual thoroughness, have a strong scientific staff at the Cameroons. The English, in their usual makeshift way, content themselves with sending home to Kew for suggestions. But the Government of India have at least tried an experiment upon the great scale. No private firm, however wealthy, would embark upon the cultivation of india-rubber; the trees take a matter of

twenty years before they can produce a pennyworth. In addition to that, cultivation must occupy a huge extent of ground of such a nature that no European can enter it during the rainy season, and where the growth is so thick that twenty men might be tapping trees within a mile of the ranger, and be none the wiser. Nevertheless, the Indian Government have a nursery of Para rubber-trees in Assam, * extending over two hundred square miles, which will in time begin to yield ; and if any department can control such a farm the Indian Woods and Forests will. Yet it seems, perhaps, a likelier scheme to carry out Sir Henry Johnston's general policy in this particular, and organise under Indian surveyors a forestry department in East Africa, where the trees exist in plenty. The industry is of course not confined to Africa and South America ; rubber comes from Assam, Rangoon, Borneo, Penang, and Madagascar, amongst other places, but last year's export from Lagos more than doubled the united output of all those that have been named. If we are to stay in Equatorial Africa, it will be a satisfaction to think that we can make some advantage out of it. What it costs to keep slavery in check from Uganda to Commassie only mothers know who have sons in those happy regions. Civilisation is spending a great deal of energy on Africa, and one will be glad to find that Africa makes some return, if it be only to lower the price of pneumatic tyres.—(*Spectator*.)

* Note—The Assam plantations at Charduar are not of Para rubber, but of the Indian-rubber Fig.—(*Ficus elastica*).—Hon. Ed.

more utilitarian works are the illustrated monographs of the genera *Eucalyptus* and *Acacia*. His "Census of Australian Plants," so carefully compiled with regard to dates, references and authorities, is exceedingly useful for purposes of comparison with the floras of other countries, and has been extensively used by the writer and others. But Mueller was much more than a botanist and geographer; he was always a promoter, and often the originator, of movements for the scientific, social and material welfare of the country he had made his home. He was in turn President of the Philosophical Institute, of the Geographical Society (Victorian branch), of the Australian Association for the Advancement of Science, and various other bodies and societies. He has also the reputation of having been a most devout and philanthropical person. And, in spite of his not being a practical horticulturist he did more probably than any other person to promote commercial—that is to say, the useful development of cultural industries in Australia, and more than any other person in the diffusion of the useful Australian plants in other parts of the world. He had probably a wider correspondence than any living botanist, and few are the establishments that have not been in some way benefited by him. The value of his work consists largely in the fact that he did exactly the kind of work that was required in a young country for its material as well as its moral development. It is true that his work exhibits more industry than genius; but, after all, what he undertook gave little scope for the latter quality. There was, however, a weak side in his character, which it would be affectation to pass over entirely, though one would say as little about it as possible. He had an inordinate craving for titles, distinctions, and admiration. This led him to publish, in all sorts of places and languages, what it would have been much better to have kept together, and to indulge in vagaries in botanical nomenclature which are simply deplorable and damaging to his character as a sincere servant of science. Nevertheless, the country to which he devoted nearly half a century of active life was proud of him, and justly so, and willingly honoured him during his lifetime, and will doubtless long cherish his memory

W. BOTTING HEMSLEY.

—Nature.

Baron Sir Ferdinand von Mueller.

News of the death of this distinguished botanist and geographer reached London on the 10th October, causing some surprise, as it was not known here that his health was failing. Born at Rostock in 1825, and educated at Kiel, he emigrated to Australia in consequence of hereditary symptoms of phthisis; having previously lost his parents. Mueller belonged to the school

of botanists, now fast diminishing in numbers, who began their studies in the field instead of in the laboratory. Before leaving Europe, he devoted much time between 1840 and 1847 to the investigation of the flora of Schleswig-Holstein. On his arrival in Australia, he took service as a druggist's assistant in Adelaide, a post he seems to have held for a brief period, as he was soon engaged in exploring South Australia. From 1848 to 1852 he travelled at his own expense. At this date he was appointed, by Governor La Trobe, to the newly-created post of Government Botanist, and soon visited the previously unexplored Australian Alps. About this period he entered into correspondence with the late Sir William Hooker, which led to the publication of the results of his earlier journeys in Hooker's *Kew Journal of Botany*, beginning with the fifth volume. In 1854 the Victorian Institute was founded*—the first institution of its kind, I believe, in Australia proper, though Tasmania had its Royal Society some three years earlier: and Mueller was one of the first and most prolific contributors to its *Transactions*. It was here that he published the new plants collected in the Australian Alps.

In 1855-1856 Mueller was attached as botanist to Gregory's expedition across North Australia, from the Victoria River to the Albert River. In 1857 he was appointed Director of the Melbourne Botanic Garden; but in 1873 he was superseded, owing to his too rigidly scientific management, though he still retained charge of the herbarium and library. Great as were his exertions and enthusiasm on the introduction and cultivation of useful and ornamental plants, he failed from a practical standpoint. His work on "Select extra-tropical plants eligible for Industrial Culture," &c., was an extraordinary success; yet not on account of its practical value, for it has none, but as a work of general reference it is very useful. Nine editions have appeared, including an American, a French, and a German edition.

During the forty-nine years of his Australian life, Mueller was such an unceasing and copious writer, that it is impossible to do more than glance at some of his more important publications. It was from the first his ambition to write a "Flora" of the entire country, and his almost innumerable papers were written with this view; but when it came to the point, the task, for various reasons, was confided to the late George Bentham, and Mueller most cordially co-operated with him by sending his collections and notes to Kew. Of that I can speak with some authority, having acted a very humble, though congenial, part in connection with the earlier volumes of the classical "Flora Australiensis." Mueller, however, found enough to do in publishing the thousands of novelties collected by himself, and by others under his direction. His "Fragmenta Phytographiæ Australiæ" is the chief, but by no means the sole repertorium of his descriptions. Prominent among his

* Subsequently the Philosophical Institution, and then the Royal Society.

Dr. Henry Trimen.

The friends of Henry Trimen who saw him during his last visit to England a twelve-month ago last summer would not be altogether unprepared for a serious turn in the malady, or rather maladies from which he suffered ; yet the news of his death on the 16th October came as a surprise, even to those best acquainted with his condition. For several years he suffered from deafness, which at length became absolute, and then gradual paralysis of the lower limbs set in. This terminated not long since in utter helplessness so far as his legs were concerned, and functional complications

arising he succumbed sooner than was expected. He bore his afflictions with wonderful fortitude, and even cheerfulness; and his only desire was to be spared to complete his great work, the "Handbook to the Flora of Ceylon." But this was not to be. It is to be hoped, however, that a competent botanist will be found to complete this important and admirably planned publication.

Henry Trimen was born in London in 1843, and educated at King's College. In 1865 he graduated M. B., but he never practised medicine. His favourite study was botany, and he at first specially devoted himself to the British Flora and the sources of vegetable drugs. In 1867 he was appointed Lecturer on Botany at St. Mary's Hospital Medical School; and in 1869 he entered the Botanical Department of the British Museum as Senior Assistant. In the meantime he had published a number of contributions to British Botany chiefly relating to the Flora of Surrey, of Hampshire, and especially of Middlesex. His first work appeared in the *Phytologist* in 1862. Soon he became acquainted with W. F. Thistelton-Dyer, the present Director of Kew Gardens, and the result was their admirable "Flora of Middlesex" published in 1869. This work still holds a position in the first rank among county "Floras." In 1886, Trimen discovered *Wolffia arrhiza* at Staines; the first locality recorded for it in England. It was in that year that the writer became acquainted with Trimen and his associate and made various excursions with them collecting materials for their "Flora." In 1870 Trimen joined Dr. Seemann in editing the *Journal of Botany* and on the death of the latter he assumed the full responsibilities of Editor, which he continued to exercise until he went to Ceylon. Concurrently he was conducting his investigations in Medical Botany, and he associated himself with Robert Bentley in the publication of an illustrated work on "Medicinal Plants," a work of research, comprising four volumes containing upwards of 300 coloured plates. Passing over minor events, we come to the period when he was appointed to succeed Dr. Thwaites in the important and onerous duties of Director of Botanic Gardens of Ceylon—duties he discharged in a manner satisfactory to the home authorities and the colonists. His annual reports are models of what such reports should be. He at once took up the study of the native flora, and was soon actively engaged in the introduction of valuable economic plants of other countries for cultivation in Ceylon. The first volume of his "Handbook" appeared in 1893; the second in 1894; the third in 1895; and from his last letters we learn that he was still working with a will, in spite of his afflictions.

As a botanist, Trimen was a man of great attainments. As a friend, he was sympathetic, sincere, and constant. His work was always thoroughly and conscientiously performed, and is consequently of an enduring nature. This was recognized in his being elected a Fellow of the Royal Society in 1893.

W. BOTTING HEMSLEY.

—*Nature*.